STOCK MANAGEMENT OPTIMISATION AND COST ALLOCATION WITHIN A MEDIUM-SIZED GENERAL CONSTRUCTION COMPANY

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Executive Summary

The purpose of this consultancy report is to map and give a clear insight into the current logistic processes at De Peuter, identify the root causes of the analysed inefficiencies and give a multitude of explicit recommendations in order to optimise the company's stock management processes and cost allocation. After conducting and examining internal as well as external interviews, empirical on-site observations, several best-practices and academic research, four pathways were investigated as possible solutions.

Firstly, logistics improvements focused on improvements and innovations of the current process itself. Enhancements that can be implemented regardless of integrating with and purchasing external software or partnering up with other companies. Secondly, there has been made a comparison between the different set of possible logistics add-ons which would be integrated with the current ERP system and provide an automation of the company's stock -and cost flows. Notwithstanding the quality off the add-ons, the main concern relates to the integrability with the present ERP system, potential collaboration with an external company and the cost price. Thirdly, different ERP-systems for construction companies on the Belgian market were mainly considered based on their customised stock management solution for the company. Finally, an in-depth look was taken at relevant asset management solutions and it was verified whether these can have a significant impact on the company's stock management.

The final suggestions were retained while keeping the current as well as short -and medium-term strategy of the company in mind. The recommended actions consist of:

Logistics improvements (opting for internal process improvements)

- Following clear-cut procedures when ordering items
- Registering the equipment and material in an online list
- Establishing a clear job allocation
- Restructuring the warehouse

Logistics add-ons (opting for external hard -and software solutions)

- Investing in the Zetes or Admin2Win solution

Solely implementing a set of explicit recommendations won't cut it for actual change to take place. De Peuter needs to effectively manage this change process and find a way to not only connect to their employees but also get them to genuinely understand how their new set of actions can significantly decrease the time spent on excessive, inefficient work related tasks, impact the company's logistics processes and ultimately let the company work close to productive efficiency.

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1. Problem Statement

In the run-up to this in-company project, De Peuter expressed their concern about their logistic processes, and the need for an optimisation of their stock management and resource cost allocation. This 2nd generation family business has organically grown to its current size. This growth, however, is accompanied by an increasing complexity of operations, which renders old administration methods ineffective in present-day business process management (BPM).

Currently, De Peuter uses KPD's ERP-system BouwOffice to keep track of the administration of their projects, finance (through the WICC extension) and logistics. However, BouwOffice's user interface isn't intuitive to work with and the logistics domain is either insufficient, or it is not used to full potential. Due to the lack of usability, almost all steps of the logistics process are now registered on a paper receipt and subsequently manually registered in an excel sheet or BouwOffice. The company knows that this process runs extremely inefficient and already identified that there lies an opportunity to reduce the company's waste and resolve inefficiencies.

Historically, the warehouse inventory has never been recorded, and the stock management was mainly based on the experience of the current warehouse responsible. This person is also an all-round mechanic, which makes the stock management just a part of his professional occupation. The absence of well-defined task responsibilities sporadically leads to other employees taking and returning construction materials and equipment without any registration. This, as well as the significant manual input with frequent mistakes, has as a consequence that the company has a substantial blind spot regarding their inventory.

Whenever certain costs cannot be assigned to a project, that cost is allocated to the warehouse. This renders the projects more profitable than they really are and sees the warehouse as a critical loss-making department. De Peuter wants to make the switch to a 'leaner' way of operations to enable their administration to allocate costs to the right projects. This operational excellence will most probably cause significant cost-savings on the long-term.

2. Introduction

2.1 Intro to De Peuter Aannemingen

De Peuter Aannemingen has been an active builder and contractor since 1993 within the construction industry, being road construction, construction of commercial and public real estate as well as sector related maintenance work. The company is active from the start until the end of a project, having experience in the handling and management of all different steps within the construction process. Within their construction activities, approximately 70% is outsourced whereas this amounts to roughly 40% in road construction. De Peuter is only present in Belgium and mainly operates in the region of Antwerp.

The company currently (2019) has 47 employees - of which the majority are blue-collar workers - and has had a revenue of €12 million in 2018. In light of the company's vision, De Peuter aspires to be the reference within the region of Antwerp for the (road) construction and infrastructure industry for medium- and large-sized enterprises. The objective of De Peuter is to achieve a 5% to 7.5% yearly turnover growth and make the growth of road construction and the construction of commercial and public real estate directly proportional.

2.2 Business Process Management within the construction industry

Achieving turnover growth can be realised through improvements of the process which is the result of applying Business Process Management (BPM). BPM entails the continuous improvement of a company's processes by managers as well as employees (Burlton, 2001). It allows to manage and automate an organisation's business processes and provides opportunities to analyse the activities and Key Performance Indicators (KPIs) (Salibindla, 2017).

In order to improve the sector performance and cut costs, process improvement as a sustained practice is of utmost importance in the construction industry (Bhargav, 2017; Harmon, 2004). A case study by Bhargav (2017) demonstrated that even smaller business units and its processes affected the overall value chain in a major way. Consequently, improving the business processes can have a great impact on construction companies as a whole.

A technology that is able to support BPM and thus improve the company's processes is an Enterprise Resource Planning (ERP). It is an integrated system that automates the material, information and financial flows of a company's resources amid all functions within the company onto a common database (Kumar, Maheshwari, & Kumar, 2002). Construction companies wishing to implement an ERP system often have to select a general system while the

construction industry requires specially designed systems, which indicates that an ERP package that can meet all special business requirements or functionalities doesn't exist (Yang, Wu, & Tsai, 2007). Furthermore, the implementation of an ERP system requires an enormous investment and often fail because they are not implemented accordingly with a scalable and sustainable business approach (Scherpenseel, 2003). Knowing that no perfect solution exists, also exploring options next to the potential purchase and implementation of a new ERP system could prove to be useful.

2.3 Lean management within the construction industry

Another way to optimise the business processes is through lean management. The core idea of lean is maximising customer value whilst minimising waste (LEI, 2018). The concept stems from the Toyota production system which introduced lean manufacturing in the automobile industry (Hines, Holweg, & Rich, 2004). It can establish competitive advantages and has already been introduced into several other industries on a worldwide scale (Meng, 2019). Lean construction uses the same principles as lean manufacturing to reduce waste and increase productivity (Vidhate & Salunkhe, 2018).

In contrary to the manufacturing industry where the processes are repetitive and products standardised, the construction industry is characterised by variable process workflows while the products are often customised (Höök & Stehn, 2008; Jørgensen & Emmitt, 2008). Notwithstanding the differences between the construction and manufacturing industry as well as the different opinions as to how to implement lean thinking in the construction industry, there is a general agreement that construction projects potentially can be greatly improved through the application of lean principles (Al-Sudairi, 2007). A study by Vidhate & Salunkhe (2018) confirms that lean techniques are indeed being utilised and applied within civil industries and have proven to save costs and time, leading to better results than traditional construction techniques.

In many countries, the construction industry is an important contributor to the economy (Meng, 2019). In Belgium, the construction industry represents 5.2% of the total economy and employs 142,631 people (NBB, 2019; Steunpunt Werk, 2019). Furthermore, there is a shortage of educated personnel and construction material in the construction industry which highlights the tight labour market conditions (De Tijd, 2019). Consequently, it is likely that establishing competitive advantages through the application of lean management can prove to be very important for Belgian construction companies, especially as market conditions remain largely competitive.

3. Methodology

When looking into De Peuter's request to optimise their logistic processes, it was suggested to take a qualitative approach in analysing the current inefficiencies and identifying possible solutions. This approach was chosen over a quantitative one, as it provides insights in the rather specific characteristics of the logistics process at the company. The qualitative research was used to dive deeper into the problem and uncover trends in thoughts and opinions of the various process stakeholders. The respondents were selected to fulfil certain quota, which lead to a relatively small sample size of this research. The limited sample size renders the use of quantitative research methods futile. The research was therefore conducted by using various qualitative research methods: literature reviewing, individual interviews, observations and case studies of best-practice examples.

3.1 Approach

In advance of starting the analysis of the posed problem Google Scholar and ResearchGate, an online social network for researchers, was screened to obtain relevant publications about the topic of process improvement and its connection to the use of ERP-systems. Articles about applying these topics in the construction industry in particular were sought for and screened. This literature was supplemented with publications that were provided by the promotor of this research. The additional publications include comprehensive information about process mapping and root cause analysis. The literature was first used to gain a broad perspective of how logistics are tied into ERP-systems in the construction industry. Subsequently, this understanding served as a means of narrowing down the scope of this project.

3.2 Interviews

After a first meeting with the project supervisor, it was decided to put the logistics process in the perspective of the entire construction process, ranging from receiving an inquiry up to delivering the finished project. An elementary process map was composed, which contained all processes with a direct link to project construction and logistics (stock keeping and material and equipment handling). This tentative flowchart was used to identify the process' key stakeholders. To gain valuable insights about the company's operations and its logistics process, all key stakeholders were interviewed using a semi-structured set of questions.

Several questions were set up for all interviewees to answer, while a large portion of questions was related to each interviewee's specific function. The list of interviewees and the semi-structured interview templates are included in *Appendix 9.1* and *Appendix 9.2* respectively. During all interviews, the researchers came up with additional and follow-up questions to

clarify certain comments. Being able to have an organic conversation was the main reason for choosing a semi-structured interview design. The conversational nature of the interviews provided space for the interviewees to raise certain topics and share concerns or thoughts that otherwise wouldn't be uncovered. Most interviews were taken in an informal setting which made taking field notes the most convenient way of keeping track of the contents.

3.3 Observations

The information that was extracted out of the interviews was supplemented by observing employees performing the actual activities of processing material and equipment orders, deliveries and transfers. All process stakeholders guided the researchers through the physical steps they undertake in the administration of the logistics process.

3.4 Process Mapping & Root Cause Analysis

The methodology of analysing the company's processes was mainly based on the techniques explained by Childress & Marietta (2008). The technique of process mapping was used to construct a structured overview of the complete logistics process within De Peuter. The process flowchart was completed by applying the theoretical frameworks onto the acquired information (on-site interviews and observations) (Isik, 2019). As a first step, the 'As-is' process was laid out. The logistics process was identified as a support process for the execution of a construction or infrastructure project, which are the primary processes within the company. Then, the logistics process was segmented in various subparts, to distinguish the primary, supporting and management processes within logistics. This partition also assisted in the thorough interpretation and mapping of the different process steps. Provisional maps of the process segments were on several occasions presented to the promotor of this research to obtain valuable feedback and make adjustments where needed. The complete process maps are included in *Appendix 9.3*.

As a next step, the constructed process maps were analysed to pinpoint waste, bottlenecks and white gaps in the different parts of the logistics process. The used method for doing so was a root cause analysis in addition to using the '5 why's' and 'fishbone diagram' techniques to perform the analysis (Isik, 2019). When waste was identified in certain processes, the 5 why's technique was used to expose the root causes of each problem. For analysing the most relevant process of outbound logistics, the fishbone diagram was used to picture the identified causes. Subsequently, the 5 why's technique was executed on all problems to uncover the root causes. An overview of these approaches is included in *Appendix 9.4*.

The findings of the root cause analysis were discussed with the different process stakeholders to compose a categorisation for all the identified inefficiencies. After a short screening of the problems, three categories were created and each cause was allocated to one of the three categories: People, Procedure, Uncertainties (*Figure 1*). The categorisation was an essential step in converging the constructed 'As-is' process into a 'To-be' process. All process stakeholders' comments and expectations where screened and taken into account when drawing up this process of minimum waste.

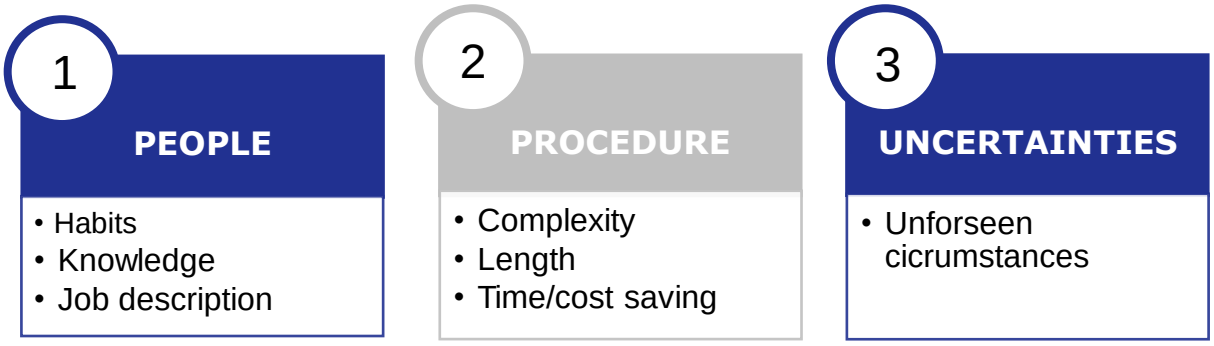

Figure 1, Root Cause Categorisation

3.5 Best Practice Case Studies

Best practices were found through internal suggestions from the company's employees, suggestions from the current ERP supplier (KPD), references on ERP suppliers and competitors' websites as well as through online web searches and recommendations obtained by means of calling prospective companies. The internal suggestions from the company proved to be very effective as it was possible to leverage the company's network and brand in order to schedule appointments. Additionally, utilising the names of previously called contacts provided a foot in the door and assisted in retrieving the desired information.

Moreover, instead of only focusing on companies with fully integrated and automated technologic solutions, companies with rather straightforward approaches were also taken into consideration. It was taken into account that elementary solutions could very well lead to great improvements within the logistic process. By visiting companies with different ERP systems, implemented by different suppliers, it was made sure that a diverse set of companies was targeted. The main predetermined requirement was the similarities in core activities. Consequently companies active in the construction industry were selected.

3.6 Solutions

After gathering information through the different research methods, possible solutions were split in four main categories: logistics improvements, logistics add-ons, alternative ERP-systems and asset management solutions.

3.6.1 Logistics Improvements

The first category of logistics improvements represents enhancements to the current process that do not require major investments. These solutions were then situated on the Action priority matrix by Geoghegan (2019) which takes the following factors into account *(Figure 2)*. Firstly "Impact": the influence a certain solution will have on the efficiency of De Peuter's operations, and secondly "Effort": the amount of time, effort and money it takes to tackle the root cause and implement a solution. Based on both determinants, each solution is plotted in one of the four slots: Quick Wins, Major Projects, Fill ins, Thankless Tasks.

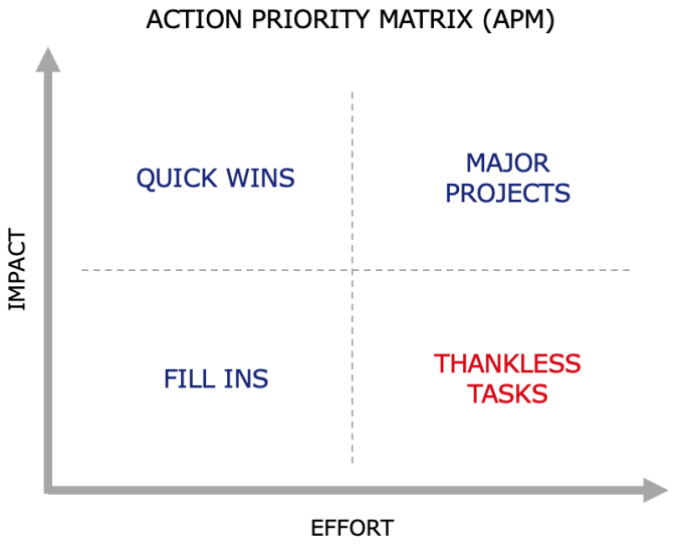

Figure 2, Action Priority Matrix

A next step in this methodology was developing a theory of action, an overview of possibilities on how the root causes can be tackled (Childress & Marietta, 2008). It is a statement about cause and effect and shows the plan with which each action can be implemented regarding training, costs, etc. The first segment of the theory of action constitutes out of the action plan.

In composing the action plan, three action domains were taken into account. Firstly, the 'procedures' domain handles everything that is related to the process flowcharts. The 'people' domain covers measures to be taken concerning employees, such as habits and training, while the 'warehouse' domain concerns all actions that can be executed within the physical warehouse.

With the action plan completed, a plan for the implementation of the proposed measures was drawn up. The implementation plan is also part of the theory of action and can be used as a guide when the decision is made to realise the proposed action plan. Next to these logistics improvements that do not require large investments, other alternatives were also investigated.

3.6.2 Logistics Add-ons

Logistics add-ons refers to providers of modular logistics or stock management software and hardware, that can be integrated with the current ERP-system. The approach in finding suppliers of these services strongly resembles the one of the best practices. The main requirement for suppliers was the adaptability for the construction industry and integrability with the company itself. Although specific budget requirements weren't given, the size of De Peuter gave a rough estimation as to whether several companies should or should not be contacted.

A first lead was given by a KPD consultant during an introductory meeting at the start of this project. When discussing the aspiration for a more automated warehouse management system, he suggested Zetes with their logistics software ZetesMedea as a provider of such services. Zetes was contacted to obtain more information and a meeting with one of the company's account managers was scheduled at De Peuter's site to discuss their product. The account manager later provided a detailed price offer that could be used for an in depth analysis.

Hilti was also identified as a logistics solution provider because of their software ON!Track. De Peuter's management disclosed that Hilti had already contacted De Peuter to introduce ON!Track in 2017. Back then, Hilti executed an on-site analysis of De Peuter's warehouse and submitted a detailed price offer. As this price offer provided a detailed outline of the implementation possibilities and costs, it was used as the basis of the detailed analysis. Hilti was therefore not contacted a second time.

A third provider of similar logistics solutions was encountered during one of the best practice visits to Hadibouw. The administrative assistant introduced Admin2Win of ETS Informatics as their software for stock management. As she showed that Hadibouw manages to keep a good overview and registration of their stock levels without making use of an ERP-system, Admin2Win was recognised as logistics software with large potential. Subsequently, ETS Informatics was contacted and a meeting with the company's founder was arranged to discuss

their solution. Afterwards, ETS Informatics made a price offer for the Admin2Win logistics module, which was used for a thorough analysis.

3.6.3 Alternative ERP-systems

The option of making the switch to an entirely different ERP-system with a better developed logistics module was also taken into account. Although De Peuter's management expressed their desire to keep using their current ERP system BouwOffice, it was decided to look into the topic anyway. This would enable De Peuter to evaluate the cost and possibilities of their current ERP-system against other products available on the market.

The selection of the most appropriate ERP solution is a semi-structured decision problem without an agreed-on and formal procedure (Hecht, 1997; Laudon & Laudon, 1998). Therefore, referrals concerning ERP systems for construction companies were asked after all the interviews as well for every opportunity during desk research. Only highly appraised ERP systems were retained. A total of 16 companies (ERP suppliers and implementers) were identified and screened.

After assessing the various alternatives and plotting them against De Peuter's situation, Microsoft's Navision, which is now called Dynamics, seemed the most adequate and feasible option for implementation at the company. It is a widely known ERP-system and is often favoured because of its high similarity and integrability with Microsoft Office. In addition, there are a multitude of companies in Belgium that implement this ERP system, and adapt it to the company itself.

Four implementers were mentioned several times during interviews with best practices, being Christiaens, GMI group, Astena and Offimac. Christiaens had ceased implementations for construction companies, GMI Group already had had close contact (rather negative experience) with De Peuter in the past and Astena was only willing to meet if there were clear intentions of implementing the ERP system in the near future. For these reasons, only a meeting with Offimac was scheduled. During this meeting, the account manager explained the potential of Microsoft Dynamics, and gave a price range for the development, installation and implementation of their solution. These data were then used in the detailed analysis.

3.6.4 Asset Management Solutions

In the process of searching for logistics add-on software and ERP-systems, one other category of logistics solutions was encountered being asset management solutions. These solutions

were not considered as stock management optimisation tools, as they only focus on the equipment and don't take the consumable materials into account. Desk research and comments in interviews identified Viloc, Geodynamics and Suivo as asset management systems. Both Viloc and geodynamics provided information through a telephone interview and a meeting respectively. The given data was then analysed by using the amount of assets that Hilti had pinpointed for the ON!Track offer they submitted in 2017.

3.7 Suggestions and Final Recommendation

After gathering data through the different research methods, a list of possible options was composed. A brief recap of all alternatives' features and costs was included and followed by a summary of the relative advantages and disadvantages. This information enables De Peuter to quickly screen and compare different alternatives and their characteristics. Taking all the data into account, one final recommendation was constructed to inform De Peuter about what was identified as the way to go. This advice should assist De Peuter's management in the decision-making process. They do however have the option to determine their most preferred way of improving their stock management and cost allocation processes.

4. Results

4.1 Current Situation

4.1.1 General overview of the current process

The current logistic process in general can be divided into two main allocations, tools/materials stocked in the warehouse or allocations to the different sites. Orders of new materials are mainly delivered directly to the site. However, replenishment of the warehouse takes up space and sometimes goods that are meant for the sites are delivered at the warehouse due to possible theft or low available space.

Each day, tools and materials for the different sites are prepared the following morning. Beside the setup of these items, excessive goods are dropped at the warehouse at the end of a project. Resulting in lots of items going in and out of the warehouse. The allocation of the material to the different sites is registered in the ERP-system (BouwOffice). The same procedure is handled for the larger machinery. The current process does not allocate smaller tools to the different sites.

The current processes are mainly characterised by excessive manual steps, double registration as well as a lack of structure, transparency and hierarchy. The whole current logistics system is divided in separate processes and mapped in flowcharts. The following processes are mapped and analysed.

- Making a tender offer
- Preparation of the project
- Setup process
- Missing or damaged tools/materials at the site
- Buying tools/materials for stock
- Delivery at warehouse
- Allocation of the tools/materials to the project

The flowcharts are included in the appendix and give a clearer overview of the current processes. Since the company already is profitable and operating at a successful level, the determined inefficiencies in the root-cause analysis indicate that there are several great opportunities the company could capitalise on.

LOGISTICS IMPROVEMENTS

DE PEUTER
AANNEMINGEN

4.2 Logistics Improvements

4.2.1 Output root cause analysis

The root cause analysis is based on the flowcharts which are included in the appendix. Each possible problem is analysed by using the five why's technique and the fishbone diagram. The following table (*Table 1*) provides a quick answer to the stated problems, these answers are elaborated in the action plan.

PEOPLE	
ROOT CAUSE	**APM**
No clear knowledge of what belongs where. *Problem:* *- Place allocation of the equipment is not followed*	Major project
Answer: All the equipment needs to have a fixed place with a clear visualisation which is understandable for everybody who enters the warehouse. Beside the visualisation, a floor plan gives an overview on where to search.	
ROOT CAUSE	**APM**
The people in charge have other tasks to complete and have no time to organize. *Problem:* *- Material setup mistakes, no place allocation for tools/materials*	Quick win
Answer: The warehouse employees need to have the time to organise the warehouse. Fixed moments need to be scheduled.	
ROOT CAUSE	**APM**
No clear job allocation for the warehouse managers/mechanics *Problem:* *- Material setup mistakes, too much people involved* *- Material setup mistakes, no clear procedure* *- On site deliveries are executed by too many people*	Quick win
Answer: Clear procedures and job allocations need to be made. Different scenarios as in urgent, absence, etc. need to be taken into account.	

ROOT CAUSE	APM
Frequent and urgent needs for mechanics and transport *Problem:* *- Lack of registration in setup phase, absence of warehouse employees*	Thankless task
Answer: An analysis needs to be made, to partner up with an external mechanical firm or to hire new people. It depends on the frequency of the mechanical tasks.	

ROOT CAUSE	APM
Not all warehouse employees have the required authority to delegate and order what is needed. *Problem:* *- Procedure unclear in missing or damaged tools/materials at the site, the managing director takes responsibility in urgent cases.*	Fill in
Answer: Clear procedures and tasks need to be made. It would be wise to allocate one person to order goods for warehouse purposes.	

ROOT CAUSE	APM
Warehouse employees do not have access to the projects' information (progress, deliveries, etc) *Problem:* *- Delivery to the warehouse, incoming goods are not accurately registered.* *– Material setup mistakes, information about scheduling of projects is unclear*	Fill in
Answer: - Give warehouse employees insights in the ordering list and an overview of the deliveries and sites. - Overview screen in the warehouse that shows the latest registrations.	

ROOT CAUSE	APM
Administrative clerk does not have the same technical knowledge as warehouse employees.	Major project

Problem: *- Allocation of the materials/tools to the projects, takes a lot of time to allocate.* *– Material setup mistakes, communication is unclear.*	
Answer: The warehouse employees need to be responsible for the online registration. They have the knowledge to select the right items and no time is lost in finding the right descriptions.	

PROCEDURES

ROOT CAUSE	**APM**
Too many steps in the procedure *Problem:* *- Material setup mistakes, availability is not known.* *- Lack of registration in setup phase, transfer note gets lost or forgotten; low value of materials are not registered.* *- Lack of registration in setup phase, small equipment isn't registered.* *– No clear overview of the inventory*	Major project
Answer: Clear procedure, online registration by warehouse employees. Lost or damaged equipment is an additional cost for the project.	

ROOT CAUSE	**APM**
Orders happen over the phone and in multiple steps *Problem: Lack of registration in setup phase, urgent equipment needs*	Major project
Answer: All the orders need to be registered online, no registration means no tools/materials.	

ROOT CAUSE	**APM**
Lack of structure makes it difficult to close off the warehouse *Problem:* *- Lack of registration in setup phase, everybody has access to the warehouse* *– Material setup mistakes, goods are taken without making a note*	Thankless task

Answer: Clear procedure, additional: restructure the warehouse that no entry is possible without approval.

ROOT CAUSE	**APM**
No clear overview of the stock *Problem:* *- Lack of registration in setup phase, everybody has access to the warehouse* *- Missing or damaged tools/materials at the site, excessive time is spent on controlling whether items are in stock*	Major project
Answer: Online registration, clear overview of the current stock and clear procedures	

ROOT CAUSE	**APM**
Alternative operating methods are not available *Problem:* *- Missing or damaged tools/materials at the site, Project leaders do not have real-time information about their projects.* *- Buying tools/materials for stock, a lot of time is wasted on checking the stock levels* *- Lack of registration in setup phase, different steps are time consuming*	Major project
Answer: Introduce new procedures to obtain a more efficient way of working.	

ROOT CAUSE	**APM**
Administrative clerk does not have access to the order receipt, or the receipt is not existent *Problem:* *- Allocation of the tools/materials to the projects, no real time data of the delivered orders.* *- Delivery to the warehouse, delay on the registration of deliveries.*	Quick win
Answer: Combining the information of the delivery notes and the order receipts can result in an allocation at the moment of delivery. However each order needs to have an order receipt.	

UNCERTAINTIES	
ROOT CAUSE	**APM**
Free space on the site *Problem: Extra costs due to making a bad decision of delivery place*	Fill in
Answer: An overview of the free space, locks on the sites	
ROOT CAUSE	**APM**
It takes additional time and effort to follow up on the required amount of materials needed at projects. *Problem: Lack of registration in setup phase, returning excess materials of previous projects are not registered.*	Thankless task
Answer: Order smaller loads of materials on a more frequent basis, based on real time progress, not taking into account the warranty period due to low chances of occurring problems.	

Table 1, Root Cause Analysis & solutions

4.2.2 Best Practice Case Studies

The following practices are based on the most remarkable ways of working in the visited and contacted companies. Some overlap is seen in several companies, these are not mentioned several times.

4.2.2.1 Hadibouw

As several companies with larger turnovers were visited, it was agreed to also shed some light on a rather small company in size and turnover to see first-hand how they are managing their equipment and material in their warehouse. Hadibouw was not only chosen because of its size, the main reason was that multiple companies gave this business as a reference as they apparently were able to successfully manage their warehouse despite limited resources.

Hadibouw managed to gradually restructure their warehouse according to a specific system. Every piece of material and equipment is attributed with a nametag which consists of three different codes. The first part uses a colour name, the second a number and the third a letter. Using ‘BLAUW1A’ as an example, the color ‘BLAUW’ refers to the location of the item being

either upstairs or downstairs. The number ‘1’ refers to the rack on which the item is placed. While the letter ‘A’ signals on which shelf the item is stored. Consequently, the company can find each piece of equipment within an instant. Additionally, all items are either branded with a yellow or white nametag. Yellow nametags signify that these items always need to be in stock, while white nametags don’t. The company has set up a pre-set template which links with their logistic software, which results in a quick and efficient creation of new nametags. Lastly, there is a place foreseen where specific orders for a client are set out. The barcodes are generated by the administrative clerk, in most cases the same barcode as the supplier is used which results sometimes in frustrations as a supplier decides to change their barcodes. Beside the warehouse structure, Hadibouw uses Admin as software for their logistic process which provides a scanning system to improve the efficiency. An interesting extension of admin is the automatic invoice reader. The program reads all the scanned invoices and the information is automatically set in the financial software.

4.2.2.2 Alheembouw

Alheembouw has known an enormous turnover increase in the last five years, going from a turnover of €60 million to almost €160 million. This is an interesting case study since they also work with KPD software (BouwOffice), yet have such a large turnover.

Alheembouw manages to successfully prevent their employees taking equipment & material from the warehouse by simply restricting their access. They have built an extensive structure of fences equipped with electronic gates, only allowing certain employees and external clients to enter the perimeter. Since only few employees, designated to set up the orders and register the in-and outgoing orders are in charge of this process, every transaction is registered. Consequently, there are no gaps, resulting in a complete and transparent registering process as well as correct overview of the company’s stock levels. The warehouse itself is divided in different zones, every construction site as well as every project leader have their own loading zone. Prior going to the construction sites, the project leaders and other employees come pick up their materials and equipment at the designated zones as these items were securely put in place by the responsible warehouse employees.

4.2.2.3 Beneens Bouwonderneming

Beneens was contacted because of their size, growth and turnover. Having twice the turnover, De Peuter aspires to reach the level and size of this company. Furthermore, the company also started as and still is a family business as is De Peuter.

At Beneens, a best practice stemming from the company Heijmans was adopted. All the equipment being taken to the construction sites is allocated to the van carrying these items. Next, this van is in its totality booked to that specific project (cost wise), which limits the manual input into the ERP-system. Furthermore, the company uses colson straps with different colors to indicate which pieces of equipment have been inspected in which period. Ensuring that employees can easily recognize equipment that is yet to be inspected.

4.2.2.4 Strabag

Strabag is the number one construction company in Belgium, Strabag Belgium is a part of the international Strabag Group that is active worldwide.
Strabag group has 73 thousand coworkers and makes a revenue of € 14 billion a year. (Strabag, 2019)

At Strabag each project operates as a single company with its own revenue and costs, therefore Strabags' warehouse also operates as a single company. When items are ordered at the warehouse, all the costs (material, transport) are invoiced towards the project. The location of the different projects is sometimes far away from the warehouse, therefore contracts with nearby suppliers are signed in case of urgent need of material. These contracts provide a reduction on the normal price when an item is bought or rented, beside the reduction it allows the employees to get the items very quick.

In all projects the problem of having excessive material occurs, which leads to three options, either they resell to the supplier, throw the material away or an email is sent to the different project leaders of Strabag to reuse these materials. The equipment itself is in most cases allocated to the new project of the project or site leader. These allocations are processed via a list which is sent to the warehouse, including that following items can be allocated to another project.

4.2.3 Action plan

The action plan is based on all the findings throughout the previous analyses and benchmarking during multiple company visits. It is important to see the following actions as a guideline towards more efficiency. De Peuter has to revise all the potential improvements as a well-considered decision. The plan is divided in three main elements, Procedure, People and Warehouse. A detailed description of the to be taken actions is found in *Table 2*.

4.2.3.1 Procedure

Throughout the analysis, it became clear that a lot of word-of-mouth communication is used in the different processes, often resulting in no registration of work events. Beside the communication, many steps are handled in their allocation process. Even a clear procedure for the multiple tasks is not introduced towards the employees. Resulting in many different options that are handled by multiple people which is making the procedures more complicated and not efficient. The lack of efficiency results in a needless cost-making driver which can be easily avoided. The analysis showed that the company needs to make clear procedures for the different tasks and scenarios, and allocate specific people to these tasks. This approach applies to the ordering and the allocation process. The current ordering process is handled by multiple people, resulting in different manners of making these orders.

4.2.3.2 People

In the procedures is stated that many different ways of working are used in the current system, a large effect of this inefficient way of working is the involvement of too many people in the process. It is clear that working towards a more efficient process, tasks need to be allocated in a better way.

4.2.3.3 Procedure

The current warehouse has no clear overview of the stock. Many items are stored without any place allocation. Resulting in items which are stored without any purpose in the future, only warehouse employees have a clear view of the place allocation, whereas availability of tools or materials is unknown. The warehouse needs to be rearranged with a thorough strategy of implementation.

Action	Software/equipment	People involved	Remarks
PROCEDURES			
Clear procedures need to be made concerning the ordering. Only project leaders can make orders at the warehouse or external parties for the projects. However not for the warehouse.	All the orders must go via BouwOffice or email by using a general template.	- Project leaders - Warehouse employees	- Multiple scenarios need to be taken into account as absence or urgent cases. - A fixed hour needs to be agreed that an order for the next day is still doable. - Warehouse employees order the stock items.
Introduce a new policy that implies that all orders need to have an order receipt. These order receipts need to be stored in a shared file.	The shared file can go via the server or the ERP-system	- Project Leaders - Warehouse employees	All the order receipts need to have a clear name (e.g. ProjectNumber_DateOfDelivery_..)
Warehouse employees need to register the items via an online list. The employee selects the items out of a list and registers the amount and project it went to.	A shared excel with a list of all the items can be introduced in the warehouse. If the ERP-system provides the possibility it is appropriate to use the ERP.	- Warehouse Employees - Administrative clerk	The list contains a history of all the registrations. This is not an overview of the availability because this needs to be integrated in the ERP-system. The description is linked with the item number.
The administrative clerk can allocate the items to the project more easily by using on the one hand the shared excel with all the registrations and on	The administrative clerk must have access to the shared excel file and the shared file	Administrative clerk	- It is important that mistakes in the registration or order receipts are reported and solved immediately.

the other hand the order receipts in the shared file.	containing all the order receipts		- Allocation is based on the order receipt and the delivery note, therefore she doesn't need to wait for the invoice.
All the tools and material which are rented from the warehouse need to have a cost. The cost starts when the item leaves the warehouse and stops when it returns at the warehouse. No costs based on hours of work.	- The registration can be inserted in the shared excel file. - It is important that the project leader has an overview on the rented material on the different projects.	- Warehouse employees - Project leader - Site leader - Foremen - Administrative clerk	- The tools in the vehicles can be grouped together. The items in these vehicles must be checked each 6 months (inventory). - The cost is an incentive towards the project leaders to return the material if they do not use it. - In some cases, the cost will be higher than the renting cost at an external party, if this is the case an analysis needs to be made if the inventory cost is not higher than the revenue. - The large machinery also needs to be allocated in this way and not based on the machine hours.
Tools or materials that are lost or damaged results in a cost for the different projects. The cost is the amount spent on the order of new tools or materials.	- This needs to be registered in the ERP-system.	- Warehouse employees - Project leader - Site leader - Foremen - Administrative clerk	- If an old machine is broken down no cost are allocated to the projects. - When new machinery is bought, the overview of material needs to contain this information (think: inspections)

When an order with a delivery at the warehouse is made, a file needs to contain the information of the delivery date. The warehouse employees need to have an overview of the deliveries each day and the ordered items.	- A shared excel file or an agenda can give an overview of the deliveries for each day. - The ordered items can be retrieved from the shared file containing all the order receipts.	- Warehouse employees - Project leader	It could be useful to give the overview on a screen in the warehouse. This way all the warehouse employees have an overview.
Give the warehouse employees information about the different projects. Address of the project, kind of project, status, etc.	Give the warehouse employees access to the required information	- Warehouse employees - Project leader	It depends to what extent the information can be obtained. This action is based upon request of the warehouse employees.
Looking towards a more lean approach, multiple orders are more efficient than having a lot of excessive material.		- Project leader	Taken into account the different editions of specific items (e.g. colour bricks).
Do not stock all the excessive material, a clear procedure needs to be written when a material is stocked or thrown away. The procedure could contain an email with some pictures,	Clear procedure	- Project leader - Warehouse employee	The warranty timeframe doesn't need to be considered because the risks that this occurs is very low.

to inform all the project leaders of the excessive material.			
PEOPLE			
Individuals need to be responsible for specific tasks. It gives the benefit of a specific contact person for the different procedures.	Clear job allocations next to the clear procedures.	All	- Being responsible for a specific tasks creates a feeling of more involvement in the process. - The most urgent cases are warehouse, transportation and maintenance. - It is clear that the warehouse needs at least one full time employee.
An analysis needs to be made if maintenance can be outsourced to an external company or a new employee can be hired	List of the maintenance works	- Warehouse employees - Safety coordinator	How much maintenance does it take, how much time/costs is spent, how much does an external partnership cost.
The most important part of the analysis is to convince the people of making a registration of all the tools and materials			It is beneficial for all the employees at De Peuter.
WAREHOUSE			
Make a restructuring plan containing visualisation in the warehouse itself but also a floor plan which results in a clear overview.	Making a clear restructuring plan	- Warehouse employees	- Not only warehouse employees need to find their way in the warehouse. - The visualisation can be placed on the racks themselves.

			- Colour codes could be a useful way of working - Update sessions need to be planned to review the visualisation plan, adjustments are crucial in start phase.
If a material is out of use, this needs to be registered as "unavailable"	Registration in the shared excel file	- Warehouse employees - Administrative clerks - Safety coordinator	
Warehouse employees need to update the prices of the items in stock.	An overview of the price of the ordered items.	- Warehouse employees	In this process shall the warehouse employee check if it's still feasible to stock the items, compared to external renting. - For convenience purposes, it would be recommended to work with one average price.
Make a pick-up zone for the workers, they are not allowed to go beside this zone (clear communication).	Clear procedures and communication towards the workers and warehouse employees	- Workers - Project leaders - Warehouse employees	In the future, fences could be an additional solution.

Table 2, Action Plan

4.2.4 Logistics improvements: practical applications

4.2.4.1 Keep the warehouse clean & reduce clutter

Assigning a couple of hours per week, or even per month, to cleaning the warehouse, can have a substantial impact on the efficiency. Orders will be found more quickly and personnel will have the ability to move around faster, thus losing less time while performing the same tasks. Besides, a disorganised warehouse might reveal to suppliers, clients, visitors and even staff that there is an obvious lack of effective warehouse management (Allais, 2019; House, 2013).

4.2.4.2 Adopt lean practices

Implementing a lean strategy for the warehouse means that only the goods that are actually needed are being stocked. This reduces the overall inventory and leads to warehouse employees having to sift through less items while performing their job. Lean practices also means that, if possible, safety stocks should be reduced according to Just-in-Time principles. One way of decreasing the safety stock is by ordering smaller loads on a more frequent basis (Overflo, 2016).

4.2.4.3 Keep track of inventory error rates

Pick and pack errors are always prone to occur, even in the most efficiently organized warehouses. Keeping track of the errors and analysing this data can give key insights into which mistakes are made most frequently, and can uncover areas with substantial room for improvement (NPF, 2014).

4.2.4.4 Increase the use of stackable shelf bins

Maximizing the use of stackable bin shelves is a way to easily store smaller materials, in high demand. One of the main benefits is that they can be stacked on top of each other, and therefore making maximum use of the vertical space (Oaks, 2015).

4.2.4.5 Regularly train warehouse staff

Regular trainings for warehouse employees are key in raising awareness on the importance of maintaining an organized warehouse, as well as using the available means to keep the inventory up to date. By organizing mandatory training sessions, efficient warehouse management can become part of the company culture (Newcastle Systems, 2016).

4.2.4.6 Implement cycle counts

An inventory counting cycle should be adopted. This cycle can be monthly, quarterly or any chosen time period. Warehouse employees should make sure to routinely count the inventory at least once in the given cycle. As this helps in identifying stocking errors, it enables the warehouse employees to more accurately keep the inventory numbers (Newcastle Systems, 2016).

4.2.4.7 Eliminate non-value added actions

The entire logistics process should be examined, at least once a year. Reviewing the process is a means to make sure that no redundant steps or actions have crept in. Additionally, it is very logical to investigate the product mix every now and then. 'Popular' or frequently used items should be stored in a reachable spot a opposed to certain items that are only to be taken out sporadically. Also, when material or equipment arrives in warehouse, check for pending orders or shortages. This way, double stocking efforts can be prevented (Kruggel, 2016).

4.2.4.8 Create zones based on pick type / slotting

The warehouse should be divided in zones, based on the pick type of the items. By grouping goods with similar storage and picking methods, the order picking process can be simplified and fastened. By eliminating the employees' walk and search time, slotting will positively transform the accuracy (Pontius, 2019).

4.2.4.9 Classify inventory

Classifying the inventory depends on a whole range of factors. The size and weight and the frequency with which stored goods are retrieved are key in determining the inventory classification. Classifying all goods has proven to be particularly efficient, and not only concentrating on optimizing the 20 percent fast-moving goods that account for 80 percent of the warehouse traffic. It's especially these less frequently retrieved goods that cause the warehouse employees to cover larger distances and lose more time while searching them, therefore causing increased costs (Intralogistics, 2015).

4.2.4.10 Ensure adequate aisle space

Warehouses are naturally crammed with as much inventory as possible. However, placing the shelves too close together or storing products in the aisles, can have a negative impact on the merchandise moving time. Storing or retrieving items could take minutes instead of seconds (FDM4, 2019).

4.2.5 Implementation Plan

The most important outcome of the analysis is convincing the employees of the necessity of process improvement, which would benefit all of De Peuter's employees. Doing so will definitely take a considerable amount of time (and costs) in meetings and trainings. However, If management is able to get everybody on the same page, the company's operations can improve drastically. This goal can be achieved by organising meetings with several stakeholders in the different processes and composing efficient 'as-is' procedures. The flowcharts of the current processes can be useful as well as the topics that were mentioned in the action plan. It is important that all stakeholders are convinced of the procedures and see the added value for the different parties. These procedures should be combined with clear job allocations. It was clarified that several employees currently execute multiple tasks without a clear job description. It is of great importance to have different scenarios in mind.

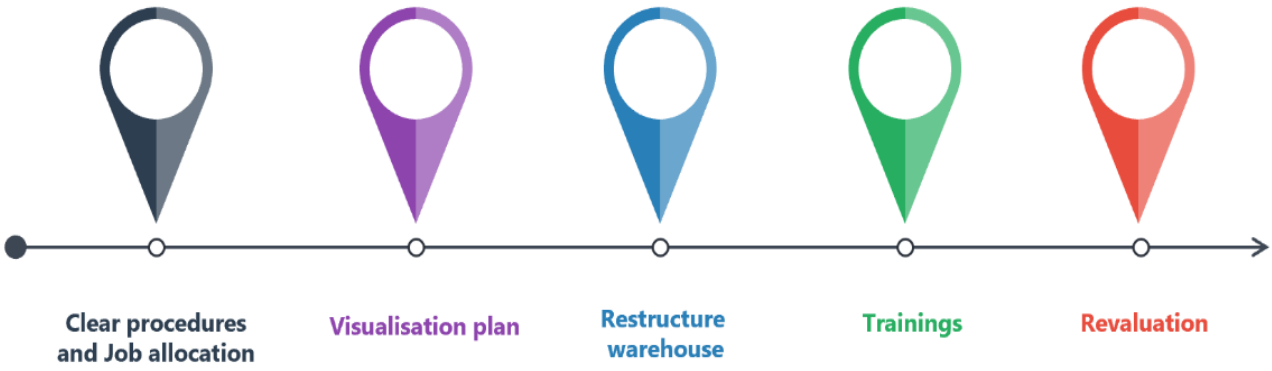

Figure 3, Visualisation of the Implementation Plan

Next to 'as-is' procedures and clear job allocation, the organisation of the warehouse will also induce a large cost in time value. Before starting the warehouse reorganisation, the team will need to look into a way of structuring, while keeping the tips of the action plan in mind. As soon as a clear strategy is formulated, the reorganisation can start. Several weeks will have to be allocated to this reorganisation, as completing this properly is crucial for long-term success. While the reorganisation is ongoing, an inventory of all the tools and materials needs to be listed. The list should contain a proper description of the items and additional pictures can be useful. The inventory could then be inserted into the ERP-system or a shared excel file, depending on future decisions.

When the restructuring process of the warehouse is completed, trainings and info sessions about new working methods can kick-off. It is essential that this step is done properly as its

outcome cannot be underestimated. Old habits will need to change, which often results in frustrations among the employees. The only way to prevent these frustrations is clear communication and insights into the process. After the implementation of the new processes, a revaluation of the processes is of great importance. Collecting feedback from all employees and adjusting where possible is key in maintaining the obtained efficiency. Although it seems as if all processes are running smoothly, this phase of the implementation process should not be neglected.

Besides the implementation processes itself, a model of a possible procedure is attached in *Appendix 9.5*. This procedure concerns the ordering and setup process of the tools/materials at the warehouse, this is a model without the interaction of any stakeholders. It gives a view on how the procedure could look like.

LOGISTICS ADD-ONS

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4.3 Logistics Add-ons

The following suggested improvements resolve several root cause problems. Expected solutions & advantages:

- Extra time savings which can be allocated to organising the warehouse
- Very clear procedure & easier job allocation
- Efficient and correct registration of incoming –and outgoing stock
- Insights of the material & equipment's movement, location and availability in the ordering list as well as information about the different projects.
  Availability of real-time information
- Online registration, unburden administrative work
- Clear overview of the inventory, known availability

4.3.1 Hilti - ON!Track

Hilti is a leading equipment manufacturer in the construction industry (Hilti, 2019). Next to producing high-quality construction tools, Hilti also provides software and services for construction professionals. The company claims to be a one-stop-shop, by offering not only products and machinery, but also design-software, training, maintenance, testing and advice.

Hilti's machinery tracking software 'ON!Track', is particularly interesting for this case (Hilti, 2019). ON!Track is a cloud-based software system, combined with material and equipment tags. The tags come in different forms and can therefore be attached to the machinery in different ways to ensure the most suitable and robust attachment for different types of equipment.

The tags enable users to keep track of their material and equipment (Hilti, 2019). The tracing system delivers an overview of which equipment is owned and where it is located. Additionally, the tags can also indicate who is using the machines and when maintenance is required. This information enables a more efficient use of equipment and machinery and leads to an overall increase in profitability of the construction projects.

In 2017, De Peuter, had already considered using Hilti's ON!Track solution for their logistic challenges, up to the point where Hilti constructed a detailed price offer after performing an in-depth on-site analysis. Although De Peuter judged the implementation cost too high at the time, the price offer could now be easily used to analyse Hilti's Logistics solution for De Peuter.

Hilti's proposed solution was to label equipment and consumable materials with suitable RFID tags, in order to track relocations between the warehouse and different construction sites via an RFID scanning device (Hilti, 2017). This solution claimed to tackle De Peuter's challenges of transparency & responsibility, stock management and registration process. In- and outbound goods would be scanned to centrally register their project allocation. These transfer data could be extracted in an Excel file and later put into BouwOffice. Although a direct input into the ERP-system does not seem possible.

The detailed analysis revealed that De Peuter possesses a total of 1,491 articles, of which 1,048 assets and 443 consumables, that qualified for labelling (Hilti, 2017). Therefore, 1,607 labels would be needed to have a sufficient amount of spare parts. The tags would come with a cost of €3,135. This initial investment price would be supplemented with a €15,364 service cost for the implementation. These costs mount to an initial investment of €18,499.

Making use of the software and the scanning device corresponds with a yearly license cost of respectively €5,940 and €1,116, totalling to a yearly EUR 7,056 licensing cost (Hilti, 2017). According to Hilti's calculations, however, this cost would be accompanied with yearly savings of €11,916. The cost savings consist of €3,600 for an increased transparency and €8,316 for the acceleration of the registration process. De Peuter's yearly net savings would therefore be €4,860 when using Hilti's ON!Track solution.

Costs	
Tags cost	3,135 €
Implementation cost	15,364 €
Total investment cost	18,499 €
Recurring yearly software licensing cost	5,940 €
Recurring yearly scanning device cost	1,116 €
Total cost year 1	**25,555 €**
Total annual cost	**7,056 €**
Savings	
Increased transparency	3,600 €
Acceleration registration process	8,316 €
Total annual savings	**11,916 €**
Total annual net savings	**4,860 €**

Table 3, Hilti ON!Track Price Specifications

4.3.2 Zetes - ZetesMedea

Zetes is a supply chain technology provider for different industries, such as transportation, logistics, retail, production, etc (Zetes, 2019). The company has over 30 years of supply chain experience and currently employs 1,200 people. In 2017 Zetes joined the Panasonic corporation and now operates as an autonomous subsidiary of the mother company. The company declares that their solutions help other companies achieve agility, visibility and traceability across their supply chain.

For optimising the logistic processes in particular, Zetes offers ZetesMedea (Zetes, 2019). The solution is compatible with different ERP-systems to optimise following processes: inbound logistics, order picking, voice directed picking and outbound logistics. Additional services include real time inventory, responsive cross docking and timely replenishments.

The software is enabled by the usage of scanning hardware (Zetes, 2019). Zetes is the largest partner in Europe for the leading hardware manufacturers; such as Zebratechnologies and Honeywell. Due to the open approach, customers can reuse purchased technology when implementing ZetesMedea. Specialists will advise (potential) customers on the most appropriate technology for their operations. Possible options include: handheld devices, wearables, truck mount terminals, RFID, voice technology, printers and labelling systems and wireless infrastructure.

ZetesMedea provides a seamless integration with any WMS (warehouse management system) or ERP-system, which could extend the functionalities of BouwOffice (Zetes, 2019). Moreover, Zetes is KPD's preferred partner for linking a logistics add-onto their ERP BouwOffice. Zetes was therefore suggested by a KPD consultant during this project's first meeting. In addition, an interview with the construction company Cordeel confirmed the achievability of integrating Zetes with BouwOffice since they have had a successful integration with the two systems to date.

As a result of this recommendation, a meeting with a Zetes account manager was planned at De Peuter to learn more about their solution. During this meeting, the capabilities of ZetesMedea were assessed and put in the perspective of De Peuter's current (and future) needs. Zetes' account manager also evaluated the current logistics or warehousing situation and suggested the, according to him, most appropriate soft- and hardware package.

To accommodate De Peuter's registration needs of in- and outbound logistics, the suggested package would consist out of the logistics software, directly linked to the ERP-system, two scanning devices (with accessories), and the required licenses for using the solution.

At the end of the meeting a, rough price estimation for the proposed package was given at €12,000 for the software package with a perpetual license. The purchasing cost for each scanning device would be in the range of €1,000 to €1,200. An optional software support contract was also discussed and was estimated at €3,000 to €4,000 for a three to five year contract.

As De Peuter's ERP-system is BouwOffice, the account manager followed-up by contacting KPD to obtain detailed information about the integration possibilities. The integration would be based on Zetes' previous experience in applying their logistics solution to BouwOffice at other construction companies. This information was used to construct a detailed price offer for De Peuter's profile.

The detailed price offer showed that development, installation and implementation of the software is offered on a cost-plus basis and the fee would lie within the range of €10,000 to €12,000 (Zetes, 2019). This includes one day of on-site work. Additionally, Zetes offers a detail-analysis, which goes at €900/day and would take approximately two days.

The purchase of two Honeywell scanning devices and accessories would amount to roughly €3,750 (Zetes, 2019). Regarding licenses, Zetes applies perpetual licensing for their software as well as the scanning hardware they provide. The one-time licence for the software and interfacing with BouwOffice costs €2,000 and the hardware licence (including communication software) costs €845. This leads to a total licensing cost of €2,845. Including the implementation cost, the total investment cost is €15,550 to €17,550.

The returning cost consists out of hardware and software maintenance contracts (Zetes, 2019). As opposed to the software support contract, which is optional, the hardware maintenance contract is obligatory and would cost €896.7 or €1,484 for a three- or five-year term respectively, which comes down to roughly €300 per year. When the first term expires, the contract can be renewed annually. The price of the optional software support contract con only be determined after the detail-analysis which causes to rely on the rough estimation of €3,500 annually. The total annual cost would therefore come down to approximately €300 or €3,800, depending on whether the software support contract is chosen or not.

According to this price offer, implementation of the Zetes solution would require an initial first year investment of roughly €18,395 to €20,395. Depending on the chosen support contract, this investment is later supplemented by recurring annual costs of approximately €300 or €3,800.

	BEST CASE	WORST CASE
Development, installation and implementation	10,000 €	12,000 €
Detail analysis	1,800 €	1,800 €
Two Honeywell scanning devices	3 ,750 €	3,750 €
One-time software license	2,000 €	2,000 €
One-time hardware license	845 €	845 €
Total investment cost	**18,395 €**	**20,395 €**
Hardware maintenance (obligatory)	300 €	300 €
Software maintenance (optional)	3,500 €	3,500 €
Total cost year 1 (without support contract)	**18,695 €**	**20,695 €**
Total cost year 1 (with support contract)	**22,195 €**	**24,195 €**
Total annual cost (without support contract)	**300 €**	**300 €**
Total annual cost (with support contract)	**3,800 €**	**3,800 €**

Table 4, Zetes ZetesMedea Price Specifications

4.3.3 ETS Informatics - Admin2Win

ETS Informatics is a B2B ICT solutions provider that originated out of an accounting office (ETS-Informatics, 2019). The company develops administrative software and provides hardware and network solutions for various sectors, such as the construction- and metal-industry. The company has a particular focus on implementing their solutions at SMEs and strives for a personalised approach when developing and implementing the ICT solutions.

ETS developed their administration software Admin2Win out of two existing programs: Jobs2Win and Win2Win (ETS-Informatics, 2019). Admin2Win is a modular software package and can be used as a fully equipped ERP-system. The modular approach allows clients to separately buy and implement the desired modules. Subsequently, as De Peuter already makes use of BouwOffice as their ERP-system, only certain modules were considered for implementation.

ETS claims to provide a seamless integration with other software products that are already in use by their clients (ETS-Informatics, 2019). Although they already have successfully integrated hardware (ZebraTechnologies Scanning devices) and software (Wings Accounting) solutions with their software and have implemented this solution at different clients, they had never integrated one of their modules with any of KPD product. An integration with BouwOffice would therefore be a pilot project.

As the Admin2Win stock keeping module was examined at one of the best practice case studies, Hadibouw, it was decided to contact the company for an introductory meeting. During this meeting, the features and possibilities of ETS Informatics' stock management module were discussed and a request was made to receive a more detailed price offer.

The offer showed the price for the software package to be €5,240 (ETS-Informatics, 2019). This package includes following modules: clients / suppliers / articles, order note, projects hour/materials/3rd party registration, stock management and equipment management. Two optional expansion modules were also mentioned for €760 each: price request and invoice control. The Zebra scanning device and its accessories and complementary software would amount to roughly €2,085. A Toshiba tag printer was also included in the offer and would cost a total of roughly €615, including accessories.

The total initial investment requirement would therefore come down to approximately €7,940. This amount excludes any chosen options, as well as the integration with BouwOffice. There is no annually recurring cost.

Software package	5,240 €
Scanning device	2,085 €
Tag printer	615 €
Total investment cost	**7,940 €**
Price request (optional)	760 €
Invoice control (optional)	760 €
Total cost year 1 (without options)	**7,940 €**
Total cost year 1 (with options)	**9,460 €**

Table 5, ETS Admin2Win Price Specifications

ERP-SYSTEMS

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4.4 ERP-Systems

The following suggested improvements resolve several root cause problems. Expected solutions & advantages:

- Possible time savings
- Clear procedure & easier job allocation
- Efficient and correct registration of incoming –and outgoing stock
- Insights of the material & equipment's movement, location and availability in the ordering list as well as information about the different projects. Availability of real-time information
- Online registration, unburden administrative work
- Clear overview of the inventory, known availability

All above mentioned expected solutions and advantages are cautious estimations since the implementation of a new ERP system causes changes on all aspects of the management of a company. Change management plays a big role and determines the eventual effectiveness.

4.4.1 KPD Software - BouwOffice

De Peuter has been using BouwOffice by KPD software since the early 2000s. The employees and management have become familiar with the software and an aspect of its functionalities. There are however several aspects that could be done better and irregularities that lead to frustrations. The main problem however remains the logistic component of the system that fails to automate and/or optimise the company's stock management.

Total annual cost	**7,508.56 €**

Table 6, KPD BouwOffice Price Specifications

Notwithstanding the amount of annoyances, it was indicated by De Peuter that the management and employees were generally satisfied with the current ERP system. Taking the overall satisfaction and familiarity of the software into account, the management expressed their interest in a solution that doesn't involve the costs and time of implementing a new ERP system. Undeterred by the current situation, a closer look was taken at the ERP market for construction companies to examine whether other ERP systems could possibly fill in the ongoing voids.

4.4.2 Offimac – Microsoft Dynamics NAV

Offimac helps companies digitalise in order to improve efficiency, costs and customer service by implementing an ERP system. It has 40 years of experience in the field of digitisation with a focus on the following industries distribution, construction, renting, production, installation and service.

During the last 22 years Offimac has been implementing Microsoft Dynamics NAV, which is one of the leading ERP-systems. A large advantage of this ERP-system is the familiar interface of Microsoft. Because the software program has a large amount of possibilities it can easily be adjusted towards the needs of the client. De Peuter won't be limited with this ERP system in terms of long-term growth.

Because Microsoft Dynamics NAV is a leading system, multiple implementers are on the market which Offimac also refers to. Having the possibility of changing towards another implementer - if that would be needed in the future - is a significant advantage.

Offimac offers a totally new ERP-system for De Peuter. Using the ERP for only the logistic process is also possible but not preferable. An advantage about an ERP system is that everything is linked together which offers more automated systems.

Given that it was very difficult for the company to make an offer this early in the process, an estimate was calculated by the account manager. Taking into account a standard implementation without customization (basic license with standard modules), an additional module for stock management as well as the analysis, implementation and employee training, the total would amount to €5,500 - €6,500 per user. Since the investment cost is given per user, it was determined during the meeting that there would approximately be 12 users. This 'best-case' scenario results in a total estimated cost of €66,000 - €78,000. The yearly recurring cost amounts to €4,800.

However, this estimation should be considered with caution. During the meeting it was apparent that every little add-on, update, change or customization costs money. Through asking an extensive set of questions, it was possible to retrieve the 'worst-case' scenario which includes delays, customization and other irregularities. Resulting in a total investment of €100,000 in the first year, a yearly licensing cost of €4,800 and an undetermined cost based on the needed support.

	Best case	Avg case	Worst case
Avg. investment cost per user	5,500 €	6,000 €	6,500 €
Total annual investment cost	66,000 €	72,000 €	78,000 €
Additional implementation costs	-	11,000 €	22,000 €
Total investment cost (avg.)	66,000 €	83,000 €	100,000 €
Recurring annual licensing cost	4,800 €	4,800 €	4,800 €
Recurring annual additional costs	-	1,920 €	3,840 €
Total cost year 1	**70,800 €**	**89,720 €**	**108,640 €**
Total annual cost	**4,800 €**	**6,720 €**	**8,640 €**

Table 7, Offimac Microsoft Dynamics NAV Price Specifications

ASSET MANAGEMENT SOLUTIONS

DE PEUTER AANNEMINGEN

4.5 Asset management solutions

The following suggestions don't provide a comprehensive solution for the company's problem but do have the potential to improve certain aspects of the logistic process, mainly managing and having an overview of the company's current assets. While these don't explicitly tackle the stock management problem, they are relevant for the logistic process as a whole and could prove to be important in optimising the logistic efficiency of the company.

4.5.1 Geodynamics

Geodynamics is market leader in time registration & track and trace and also offers software to manage events, buildings, fleets, activities and equipment. De Peuter already uses their track and trace solution and a meeting was held to discuss their other services that could potentially optimise the logistic process. Concerning equipment management, the company offers RFID tags which can be attached to machines and equipment. These tags can help a company in different ways. Firstly, the RFID tags emit a signal every 15 seconds, providing an almost real time location overview of all the on-site machines and equipment. Secondly, every tag contains important information of the machine, being the date of its last inspection, name, date of purchase, notes as well as pictures. These two benefits mainly contribute to the efficiency of the inspections. The items can be found readily as well as instantly provide the correct information since it is possible to scan the items through NFC technology (compatible with smartphone).

Concerning the cost calculation, there has been made a separation between the amount of assets determined by Hilti (Hilti counted all the relevant current assets being machines and equipment while they were gathering information to make their offer to De Peuter) and the amount of assets that need to be inspected every three months or year.

Scenario 1 (Taking all assets into account):

Each tag has a cost price of €30, using the information from the Hilti study which determined that the company currently has 1,048 assets, this would amount to €31,440. One depot antenna, which would be sufficient according to the account manager, costs €650. Geodynamics advises to equip every car with an antenna, these antennas cost €250 each. Since the company owns 15 vans that would be equipped with an antenna, this amounts to €3,750. Given that the implementation cost is free of charge, the investment cost amounts to €35,840.

Every month there is a recurring fixed cost of €50 in addition to €0.5 per tag and €2.5 per antenna. Consequently, there is a monthly cost of €614 and yearly cost of €7,368. Briefly summarized, including the investment cost, the costs for year 1 would amount to €43,208. After the first year there would be a recurring cost of €7,368.

Scenario 2 (Taking all assets that are subject to inspection into account):

The company currently has 19 excavators, 400 powered and risky tools as well as 350 types of equipment. Subsequently, the company owns 769 assets that are subject to inspection which equates to an investment cost of €23,070 for the tags. Including the investment cost, the costs for year 1 would amount to €33,164 and the yearly cost rounds up to €5,694.

Scenario 3 (Investment worthy assets according to De Peuter):

Given the investment cost, De Peuter listed the number of equipment types that would certainly be worth the investment if they would consider purchasing Geodynamic's solution. After counting, 387 types of equipment were identified. As stated by the company, 10 to 15% of these wouldn't be tagged anymore since they wouldn't get through future inspections. Using a percentage of 12,5%, 339 types of equipment remain to be tagged. Applying the same calculations, the investment cost in the first year totals up to €17,684 while the yearly cost is €3,114.

	# of assets according to Hilti	**Assets subject to inspection**	**Investment worthy assets**
Number of assets to tag	**1048**	**769**	**339**
Investment tags	31,440 €	23,070 €	10,170 €
Depot antenna	650 €	650 €	650 €
Van antennas	3,750 €	3,750 €	3,750 €
Total investment cost	35,840 €	27,470 €	14,570 €
Recurring fixed yearly cost	600 €	600 €	600 €
Recurring yearly cost tags	6,288 €	4,614 €	2,034 €
Recurring yearly cost antennas	480 €	480 €	480 €
Total cost year 1	**43,208 €**	**33,164 €**	**17,684 €**
Total yearly cost	**7,368 €**	**5,694 €**	**3,114 €**

Table 8: Geodynamics Price Specifications

4.5.2 Viloc

Viloc provides compact wireless sensors which can be attached to construction machines and equipment. These emit LoRaWAN frequencies which enable to track and locate these sensors by using a minimal amount of energy.[1] It's mainly relevant for the asset management of large constructions firms. Although its main purpose today is to prevent theft, it can be valuable to have a complete overview of a company's assets, making sure that no machines get left behind. This solution could prove to be interesting once De Peuter starts scaling and when maintaining an overview of its assets starts to become rather difficult. Currently, the company owns few expensive machines and the company's employees and management exactly know where these are located. The investment cost of one tag is €36 in addition to a yearly recurring cost of €36 (€3/month), given that the company orders at least 5-10 tags. The minimum battery life of one tag is 3 years.

The account manager of Geodynamics made it pretty clear that the solution provided by the company Viloc simply doesn't work and has caused many troubles for the company Viabuild. In addition he urged the team to contact this company, which happened and confirmed his statements. Although, there is probably some truth to it, this advice should be taken with a grain of salt since these remain the words of a competitor.

	Hilti's calculations	**Assets subject to inspection**	**Investment worthy assets**
Number of assets to tag	**1048**	**769**	**339**
Investment tags	37,728 €	27,684 €	12,204 €
Recurring yearly cost tags	37,728 €	27,684 €	12,204 €
Total cost year 1	**75,456 €**	**55,368 €**	**24,408 €**
Total yearly cost	**37,728 €**	**27,684 €**	**12,204 €**

Table 9: Viloc Price Specifications

There are only two cost components, the €36 investment cost of the tags and the monthly recurring cost of €3 per tag (€36 Annually). In the following table, the number of assets to tag are multiplied times the investment and recurring cost to obtain the total cost for the first year.

[1] A Geodynamics account manager claimed that the solution provided by the company Viloc does not suffice and has caused many troubles for the company Viabuild. In addition he urged the team to contact this company, which happened and confirmed his statements. Although, there is probably some truth to it, this advice should be taken with a precautions since it's a competitor's remark.

3.5.3 Suivo Telematics

Suivo Telematics offers GPS tracking, navigation and time registration. When a comparison is made with Geodynamics, the current partner of De Peuter, there are very few differences. Given that the company is satisfied with the offering of Geodynamics, there aren't any significant differences that would make switching companies worthwhile at the moment. No official quotation was eventually offered by the company but it was confirmed that it would have been a competitive one, similar to the alternatives on the market.

5. Suggestions

5.1 Logistics Improvements

These improvements have an immediate impact on the processes without large investments. A small summary of the quickest improvements.

- All orders contain an order receipt
- Only warehouse employees register the in- and outgoing items
- Clear procedures and job allocation
- Restructure the warehouse together with a visualisation plan

+	-
Low costs Clear overview Immediate impact	Takes time Frustrations among the employees (old habits)

5.2 Logistics Add-ons

5.2.1 Hilti – ON!Track

Hilti is a construction equipment manufacturer as well as a software and service provider. Their stock management solution ON!Track is a cloud-based software system combined with material/equipment tags and scanning devices.

Total cost year 1	**25,555 €**
Total annual cost	**7,056 €**

+	-
Use of RFID tags Real-time registration (WiFi) Specialized for construction industry Qualitative product	High cost, especially recurring costs Focus on equipment Employee learning curve

5.2.2 Zetes – ZetesMedea

Zetes is a supply chain technology provider and offer ZetesMedea as their logistics solution. ZetesMedea is a software system and works with scanning devices and barcode tags for material and equipment. It's an open software that allows integration with BouwOffice.

	BEST CASE	WORST CASE
Total cost year 1 (without support contract)	**18,695 €**	**20,695 €**
Total cost year 1 (with support contract)	**22 ,195 €**	**24,195 €**
Total annual cost (without support contract)	**300 €**	**300 €**
Total annual cost (with support contract)	**3,800 €**	**3,800 €**

+	-
Experience in construction industry Innovative scanning devices Real-time registration Number one partner for hardware providers Have successfully integrated their solution with BouwOffice at various other companies	Expensive Unclarity about software support contract and recurring costs Employee learning curve Discussions and costs with two parties (KPD & Zetes)

5.2.3 ETS Informatics – Admin2Win

ETS informatics is an IT solution provider that is able to offer a specific logistic module, including a complementary hardware scanning device which both allow to automate the in- and outflows of material and equipment within the company.

Total cost year 1 (without options)	**7,940 €**
Total cost year 1 (with options)	**9,460 €**
Annual recurring cost	**0 €**

+	-
Highly personalised approach Modular system Experience in construction industry Innovative company Low investment Fast implementation time (2-3 months) Real-time registration (WiFi)	No integration guarantee Iron can hinder the reception of Wifi Learning curve for employees

5.3 ERP-Systems

5.3.1 KPD – BouwOffice

The lay out is dull and not that user friendly, regularly errors pop up without a clear reason, there is a lack of integration with other software

+	-
Familiarity No extra investment needed (Claim to be innovative) Financial module works well Calculation module works well Good price / quality level	Dull lay out Not user friendly Pop up errors Lack of integration with other software Charge money for every contact moment Underdeveloped reporting Project leaders barely use it Not completely integrated Not used as it should No link with different departments Not innovative

5.3.1 Offimac – Microsoft Dynamics

Offinmac is an IT company with a successful track record within the construction industry in implementing the Microsoft Dynamics NAV ERP system. It offers an integrated solution - including a hardware resolution - that connects data from every department and thus creates synergies.

	BEST CASE	AVG CASE	WORST CASE
Total cost year 1	**70,800 €**	**89,720 €**	**10,8640 €**
Total yearly cost	**4,800 €**	**6,720 €**	**8,640 €**

+	-
Familiar interface of Microsoft High customisation possibilities Lower lock-in (multiple implementers) Favours long-term growth strategy Completely integrated ERP system Discussions and costs with one company	Very high cost Implementation time Change management High risk of additional costs

5.4 Asset Management Solutions

5.4.1 Geodynamics

Geodynamics offers RFID tags which can be attached to machines and equipment providing a real-time location overview and important information of the asset. It mainly would contribute to the efficiency of the asset inspections.

Number of assets	1048	769	339
Total cost year 1	**43,208 €**	**33,164 €**	**17,684 €**
Total yearly cost	**7,368 €**	**5,694 €**	**3,114 €**

+	-
Asset location overview More efficient inspection Integrable with KPD software Company already is a partner	Not truly necessary at the moment Benefits do not justify the cost Has yet to be fully integrated Doesn't solve company's main problem Low economies of scale

5.4.2 Viloc

Viloc provides compact wireless sensors which can be attached to construction machines and equipment. These tags prevent theft and give an overview of a company's assets.

Number of assets	1048	769	339
Total cost year 1	**75,456 €**	**55,368 €**	**12,204 €**
Total yearly cost	**37,728 €**	**27,684 €**	**12,204 €**

+	-
Theft prevention and recuperation Asset location overview No range restriction	Not truly necessary at the moment High recurring costs Limited battery life No economies of scale Few expensive machines Unsure whether solution works decently

5.4.3 Suivo

Suivo roughly has the same offering as Geodynamics. It can be interesting to keep this company in mind for the future.

6. Final Recommendations

6.1 Logistics improvements

6.1.1 Procedures

6.1.1.1 Clear-cut procedures concerning the ordering of materials

It is suggested that all the orders are made by one person for the warehouse that also spends all his/her time on everything related to stock management. People in the company such as project leaders should have the possibility to enter their orders/needed material and equipment in an online shared document (e.g. Excel file or module ERP system). Subsequently, the person in charge of the warehouse and ordering gets a clear overview and can proceed to the ordering of the items. In addition, a fixed hour needs to be agreed for adding items to the ordering list in order to make the purchase still possible. Evidently, the project leaders still have the possibility and authority to order material & equipment that are specific to their construction site.

6.1.1.2 The warehouse items should be registered in an online list

In absence of a scanning system, it is fundamental that the company has an overview and knows which value of material and equipment is designated to each construction site. Either a shared Excel file with all of the items can be introduced in the warehouse or the company could opt for a tool within the ERP system. The registration makes it clear and fast to make a further allocation to the different projects by the administrative clerk. Additionally, through allocating the location and the value of these items in the ERP-system, registering the renting cost of the used tools and materials will run more effectively. It is advised that the cost starts when the item leaves the warehouse and stops once it is returned. This online list makes it clear for the administrative clerk for every used and rented item, no misunderstandings in descriptions can occur. Further, it gives the project leaders an overview on the rented items on every different project. Thus, resulting in an incentive towards the project leaders to quickly return items if these are not being used.

6.1.2 People

6.1.2.1 Clear job allocation

By giving certain individuals the responsibility for specific tasks, the people are more involved in the process and a higher efficiency will be achieved. In these cases, specific contact persons are designated to distinct tasks that only they can handle.

Proposed task allocation:

- *In charge of maintenance*: Ronny, Jan and Toon

- *In charge of warehouse as well as ordering equipment and material*: One full time warehouse employee that gets to order all the needed stock supplies. For certain goods that exceed an agreed amount, this person can ask the managing director for permission. If necessary, this person could get support from one of the people in charge of maintenance (e.g. Ronny).
- *In charge of* transport: Alongside one's job, it is suggested that this person also plans and determines the most efficient transport routes according to the needed materials and different construction sites.

6.1.3 Warehouse

6.1.3.1 Warehouse restructuring

By completely restructuring the warehouse, adding visualisation and a floor plan, the company will be able to obtain a clear overview as well as know the current and future stock levels. Including the visualisation placed on the racks (e.g. indicating product name and info), using colour codes to sort the supplies as well as regularly reviewing the warehouse structure and adding adjustments.

In case the company decides to optimise the process by implementing the proposed logistics improvements, it is important to mention that it is advised to also pursue and implement the other suggestions. Evidently, the company should start with those mentioned in the final recommendations.

6.2 Logistics add-ons

6.2.1 ZetesMedea

Zetes' logistics add-on - which consists of a hardware scanning solution - supported by the appropriate software, integrated with De Peuter's current ERP system BouwOffice - is considered and ultimately brought forward because of three main reasons. Firstly, the solution eliminates various inefficiencies such as the manual operations, the incomprehensibility for the administrative clerk and the double input just to name a few. Secondly, ZetesMedea can be regarded as an investment with a high success integration probability since the company already has implemented and integrated their solution at two similar construction companies that also use the ERP system BouwOffice. Thirdly, the company is specialised in real-time scanning solutions and is considered an expert and innovator within the supply chain industry. The company continuously invests in updating their software solutions and regularly reviews their processes and business partnerships, ensuring that its clients are using the latest and most effective solutions.

Although there is a high quality guarantee, the Zetes solutions also comes with a price. Depending on the smoothness of the integration process, the investment can run from €18,695 up to €20,695. It also would be advised to not take the software support contract (annual cost of €3,500) since the same support can be requested at similar hour rates. Zetes' solution can be summarised as a high quality, low-risk option that comes at a higher price. Also take in account that Zetes and KPD are two independent parties.

6.2.2 Admin2Win

As opposed to Zetes, the company ETS provides a logistic software module that also comes with an integrated hardware scanning solution. A key advantage of this solution is the fact that their soft -and hardware is perfectly integrated and synchronised. There are many similarities with the solution of Zetes, such as being innovative, the fact that they both have already been successfully tested in the construction industry, and the real-time registration through WiFi.

Admin2Win can differentiate itself by having a fast implementation time (2-3 months), a highly personalised approach but the biggest advantage remains the low investment cost. Admin2Win also focusses on the practicalities in the processes, how make the processes practically more efficient. It operates with an own software program that can work separately from BouwOffice, therefore a detailed overview can be found in the admin software and a general overview can be linked with BouwOffice. In the best case, this stock management solution would only require an investment of €7,940.

However, this low price also involves a high risk. Namely, the insecurity as to whether the integration will succeed, considering that the program yet has to be integrated with BouwOffice. In addition, the involved costs and irregularities within this integration process are very hard to forecast. Admin's solution can be summarised as a good quality, high risk option that comes at a lower price.

6.2.3 Verdict

It is assumed and it can be expected that both solutions (Zetes and Admin) generate equivalent successful outcomes (e.g. clear and correct overview of current stock levels, less time waste in searching material and equipment). There is no such thing as one straightforward, correct, comprehensive solution. Making the correct decision will likely come down to the aptitude of risk-taking, the amount the company is willing to invest and the best company fit (also taking the future outlook into account).

7. Conclusion

The main outcome and recommendation of this report would be to opt for either the ZetesMedea or Admin2Win scanning solution and combine this with the implementation of the recommended logistics (warehouse) improvements. Based on the growth (plans) of the organisation, it also is advised to implement other discussed logistics improvements mentioned in the action plan. Since the setting of a vision and strategy of an organisation is a dynamic, never-ending process, it is recommended to check if the proposed improvements are still in line with the company's objectives.

Deciding as to whether the organisation should opt for a new ERP system is something that should be discussed within the long-term growth strategy of the company. A layer of multiple different systems works for various companies and can continue to work based on the specific needs of an organisation. Once De Peuter wants to fully integrate their different software programs and is willing to invest ≥ €100,000 into a new ERP system, it is advised to opt for the Microsoft Dynamics ERP system[2]. Looking at a successful integration for the construction industry, the main recommended implementers of this ERP system are the companies Astena and Offimac.

The most important challenge, however, remains change management. The company should stay alert after implementation since getting the employees to really change their behaviour remains one of the biggest reasons why a solution doesn't live up to its potential. As long as the employees just take the required material and equipment instead of scanning the in -and outgoing transactions, change won't be significant. The success of implementing software as well as new methods very much relies on the practical use of the tools at hand by the employees. Another way of getting the desired behaviour change is by subtly forcing the employees to first register a transaction before taking it (e.g. installing a fence that prohibits employees from taking material before registering)[3]. Getting the people to cooperate and actually implement the proposed changes is something that will make or break the company's investments and effort.

[2] Given that the company still uses Microsoft Office
[3] See action plan

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9. Appendix

9.1 List of interviewees

In-house staff

1. Thursday May 2nd 2019, Pascal Pauwels – Project Planner
2. Thursday May 2nd 2019, Ronny Baeten – Warehouse employee/Mechanic
3. Thursday May 2nd 2019, Koen De Peuter – Managing Director
4. Friday May 3rd 2019, Chris De Peuter – Managing Director
5. Tuesday May 7th 2019, Liesbeth De Peuter – Safety Advisor
6. Tuesday May 14th 2019, Alain Daelemans – Project Leader Road Construction

Best practices

7. Friday May 3rd 2019, Project Leader - Strabag
8. Monday May 6th 2019, Piet Timmerman, Interface Manager – Cosimco
9. Tuesday May 7th 2019, Steven Taelman, Business Intellegence Manager – Viabuild
10. Wednesday May 8th 2019, Niki Van de Sande, CFO – Beneens Bouwonderneming
11. Monday May 13th 2019, Hilde Warmenbol, Administrative clerk – Hadibouw
12. Tuesday May 14th 2019, Marleen Verschragen, Purchaser – Cordeel
13. Wednesday May 15th 2019, Lucas Cornelus, Warehouse Manager – Alheembouw

Add-ons

14. Tuesday May 14th 2019, Kris Lombaert, Account Manager – Zetes
15. Tuesday May 21st 2019, Kristof Platteeuw, Account Manager – Geodynamics

ERP-systems

16. Tuesday April 30th 2019, Jesse Bundgen, BouwOffice Consultant – KPD Software
17. Friday May 10th 2019, Nadia Lepot, Account Manager - Offimac

9.2 Templates of semi-structured interviews

9.2.1 Best practice companies

Introduction

Good morning / afternoon, we're students at Vlerick Business School and are currently working as consultants for De Peuter Aannemingen in the context of completing our Master. We're currently examining the logistics department of De Peuter Aannemingen in an attempt to optimize the material & equipment management solutions. Currently, the company mainly inputs the material and equipment manually, often resulting in double input and inefficiencies. The reason we're contacting your company is to assess and determine how you are coping with these challenges, take a look at your ERP program and possible integrations with logistic add-ons.

We're mainly interested in the activities of the employees responsible for the warehouse and input of material & equipment within the ERP system. How you are able to efficiently register incoming orders, outgoing goods and general updates of stock levels (e.g. when excess material gets returned to the warehouse). The goal is to determine how you are able to organize this process successfully by identifying the operations, tools, programs and adjustments that are responsible for this.

This interview will take up between 30 and 90 minutes. Everything that you share is confidential. The research report will only include summarized results and your name won't be mentioned. We first start off with a number of introduction questions. Subsequently we will present a number of scenarios in which you will have to answer several questions concerning a specific situation. Finally, we will end with some closing questions.

Interview questions

Introduction

1. What is your function title?
2. What does your job consist of?
3. Who do you most often work together with?

Topic 1: Logistics

1. Who is responsible for the warehouse management?
2. To which extent are you involved in the logistics process and the stock management?
3. What do you know about the entire logistics process? Can you guide us through all the steps?
4. Do you have a clear overview of the stock levels?
    a. What would/do you use it for and how frequently?
5. How is the delivery, transfer and departure of materials and equipment registered?
    a. Is this always done accurately and efficiently?

Topic 2: Projects

1. Who is responsible for ordering materials at the start of a project?
2. How are the orders executed?
3. Are materials and equipment transferred between different projects?
    a. Does it happen often?
    b. How is it registered?
4. What happens when a project has consumable materials in excess?

Topic 3: ERP-system

1. Do you know which ERP-system … is using?
2. Did you ever work with another ERP-system?
    a. Which one and when?
    b. What were the advantages over …?
    c. What were the disadvantages to …?
3. Which other programs or extensions do you use while performing your job?
    a. What do you use it for?
    b. How often?
    c. What could overall be done better?
    d. Would you prefer a more integrated approach?
4. What are the top three things you like / don't like about the ERP system you are using?
5. Do you believe the current ERP system to be essential or rather redundant concerning the operations of the company?

Topic 4: Communication

1. What are your means of communication?
    a. Which ones do you use most frequently?
        i. Why?

Closing questions

1. Do you see possibilities for an overall improvement?
    a. According to you, what is the way to go?
2. Do you have any remarks or advice you want to share concerning the logistics process and stock management?

9.2.2 De Peuter staff

Introduction

Good morning / afternoon, we're students at Vlerick Business School and are currently working as consultants for De Peuter Aannemingen in the context of completing our Master. We're currently examining the logistics department of De Peuter Aannemingen in an attempt to optimize the material & equipment management solutions. Currently, the company mainly inputs the material and equipment manually, often resulting in double input and inefficiencies. The reason we're here is to determine to which extent this happens at the company, which departments most often are confronted with the in-and outflows of material & equipment as well as any operations and problems concerning the logistic process.

We're mainly interested in the activities of the employees in charge of the warehouse, as well as input of material & equipment within the ERP system. How you currently register incoming orders, outgoing goods and general updates of stock levels (e.g. when excess material gets returned to the warehouse). Moreover, we're interested in any activities within your job description that (can) influence the logistic process. The goal is to determine how you organize your job, this process by identifying operations, tools, programs and adjustments in order to track inefficiencies and eventually optimize them.

This interview will take up between 30 and 90 minutes. Everything that you share is confidential. The research report will only include summarized results and your name won't be mentioned. We first start off with a number of introduction questions. Subsequently we will present a number of scenarios in which you will have to answer several questions concerning a specific situation. Finally, we will end with some closing questions.

Interview questions

Introduction

1. What is your function title?
2. What does your job consist of?
3. Who do you most often work together with?

Topic 1: Logistics

1. Who is responsible for the warehouse management?
2. To which extent are you involved in the logistic process and the stock management?
3. What do you know about the entire logistics process? Can you guide us to all the steps?
    a. Can you explain the steps that you are involved in more detail?

4. Do you ever consult the warehouse/stock levels when making decisions?
    a. Yes
        i. Which decisions
        ii. Why? .
        iii. How?
    b. No
5. Do you have a clear overview of the stock levels?
    a. Would a clear inventory list be useful to you?
    b. What would you use it for and how frequently?
6. How is the delivery, transfer and departure of materials and equipment registered?
    a. Is this always done accurately?
    b. Where do mistakes happen?
    c. Is this done efficiently?
    d. What could improve the efficiency?

Topic 2: Projects

1. Who is responsible for ordering materials at the start of a project?
2. How are the orders executed?
3. Which goods are delivered directly to the construction site?
    a. What are the reasons for delivering certain goods at the warehouse?
4. How is the use of materials and equipment booked to a project?
    a. Equipment: per day/per hour?
5. Are materials and equipment transferred between different projects?
    a. Does it happen often?
    b. How is it registered?
6. What happens when a project has consumable materials in excess?
    a. If used, for another project, where is it booked?

Topic 3: ERP-system

1. Do you know which ERP-system De Peuter Aannemingen is using?
2. Since when has BouwOffice been in use?
3. Why was it chosen?
4. What functions of BouwOffice do you use?
    a. What do you put in?
    b. What output do you use/check?
    c. What are the benefits and advantages of BouwOffice?
    d. Do you have any struggles while using BouwOffice?
5. Did you ever work with another ERP-system?
    a. Which one and when?
    b. What were the advantages over BouwOffice?
    c. What were the disadvantages to BouwOffice?
6. Did you ever consider that switching to another ERP-system might be a good idea?
7. Which other programs or extensions do you use while performing your job?
    a. What do you use it for?
    b. How often?
    c. What could overall be done better?
    d. Would you prefer a more integrated approach?

Topic 4: Communication

1. Who do you have to communicate with during your daily job performance?
    a. What's the purpose of this communication?
2. What are your means of communication?
    a. Which ones do you use most frequently?
        i.Why?
    b. Do these means differ depending on the person you are communicating with?

Situational exercise

Considering everything that has been discussed, what is in your opinion your most important activity concerning stock management?
Answer…
Imagine, you're at your desk and this activity is started, take me through the specific steps from start to finish.

Closing questions

1. Do you see possibilities for an overall improvement?
    a. According to you, what is the way to go?
2. Do you have any remarks or advice you want to share concerning the logistics process and stock management?

9.2.3 Logistics Solution providers

Introduction

Good morning / afternoon, we're students at Vlerick Business School and are currently working as consultants for De Peuter Aannemingen in the context of completing our Master. We're currently examining the logistics department of De Peuter Aannemingen in an attempt to optimize the material & equipment management solutions. Currently, the company mainly inputs the material and equipment manually, often resulting in double input and inefficiencies. The reason we're contacting your company is to assess and determine how your solution can optimise the company's logistic process and alleviate the current problems.

We're mainly interested in how your company's solution can help the activities of the employees responsible for the warehouse and input of material & equipment within the ERP system. How the solution is able to increase the efficiency of registering incoming orders, outgoing goods and general updates of stock levels (e.g. when excess material gets returned to the warehouse). Is it possible to arrange a meeting, discussing your company's offer and checking, if necessary if it's customisable?

The meeting will take up between 30 and 90 minutes. Everything that you share is confidential. The research report will only include summarized results and your name won't be mentioned. We first start off with a number of introduction questions. Subsequently we will present a number of scenarios in which you will have to answer several questions concerning a specific situation. Finally, we will end with some closing questions. Since it remains a meeting, your company will naturally get the opportunity to present its offering and ask relevant question concerning our problem.

Formal introduction by both parties
Sales introduction by Sales Representative / Account Manager, short display of the company's offering
Disclosing our specific interest, need: see introduction

Interview questions

Topic 1: Logistics

1. How can your solution aid the employees in the warehouse (management)?
2. To which extent can your solution improve the logistic process and stock management?
3. Will your solution give our employees a clear overview of the stock levels?
4. What are the advantages and disadvantages of your solution ?
5. How is the delivery, transfer and departure of materials and equipment registered through your solution?
    a. Is this always done accurately?
    b. Where do mistakes happen?
    c. Is this done efficiently?
    d. What could improve the efficiency?

Topic 2: Projects

1. How are the orders executed with your solution?
2. If goods are delivered directly to the construction site, how can these be registered through your solution?
3. How is the use of materials and equipment booked to a project?

4. How can it be registered if material and equipment are transferred between different projects?
5. When a project has consumable materials in excess, how can these be booked using your solution?

Topic 3: ERP-system

1. Is the ERP-system that De Peuter Aannemingen is using, Bouwoffice (KPD) integratable with your logistic add-on solution
2. Yes
   i. Do you have any references that also are using Bouwoffice, which have successfully implemented this solution ?
      1. If not, why do you think it is integrable ?

3. Since when have you been implementing this logistic solution?

4. What functions of your solution do your client most frequently use?
5. Do you often customise your logistic add-on solution and adapt it according to the ERP system a certain company/client is using?

Topic 4: Communication

1. What would be the main means of communications after the implementation of your solution ?
   a. Which means do your other clients / references use most frequently?
      i. Why?
   b. Do these means differ depending on the persons they are communicating with?

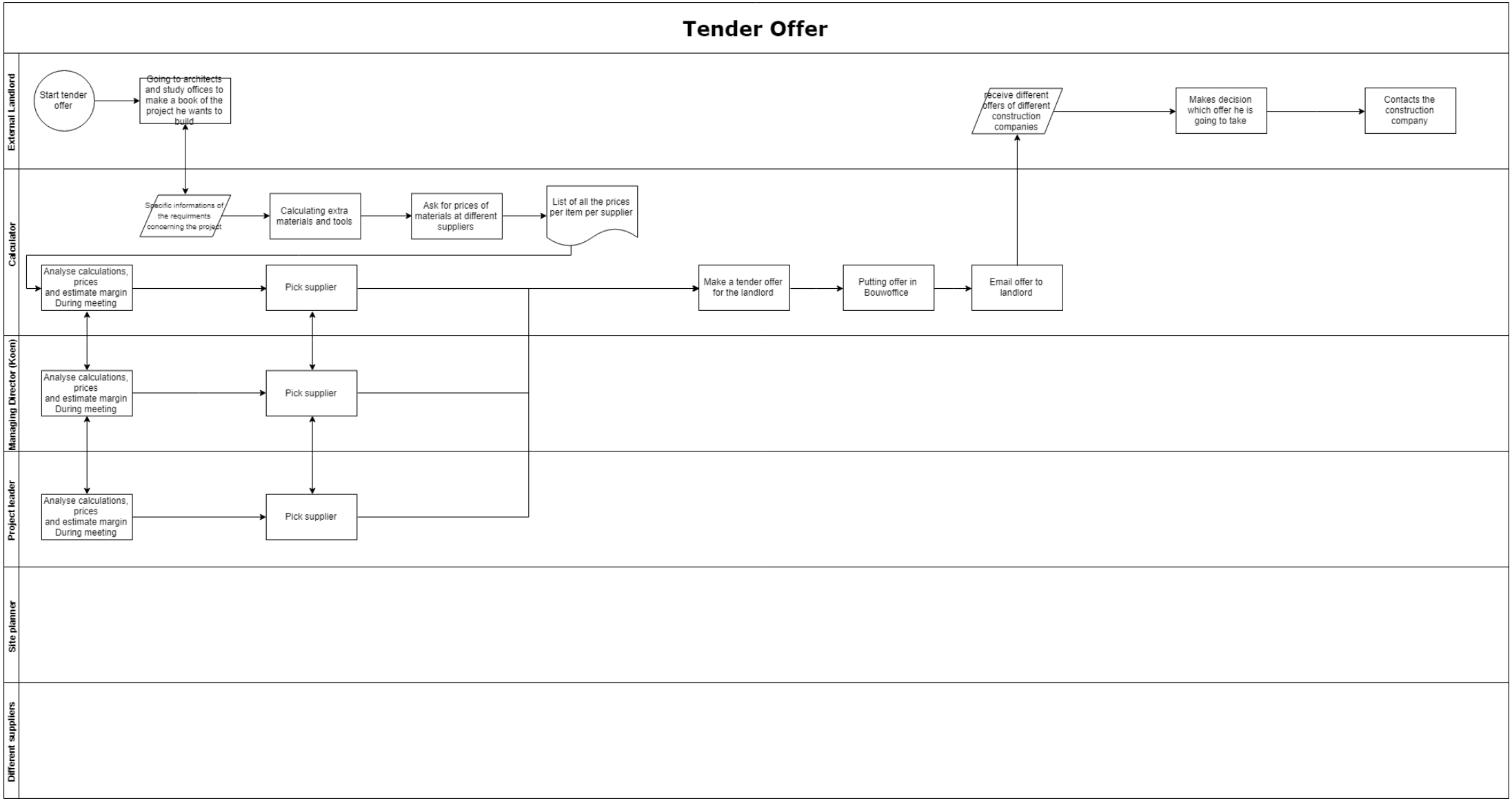
Situational exercise

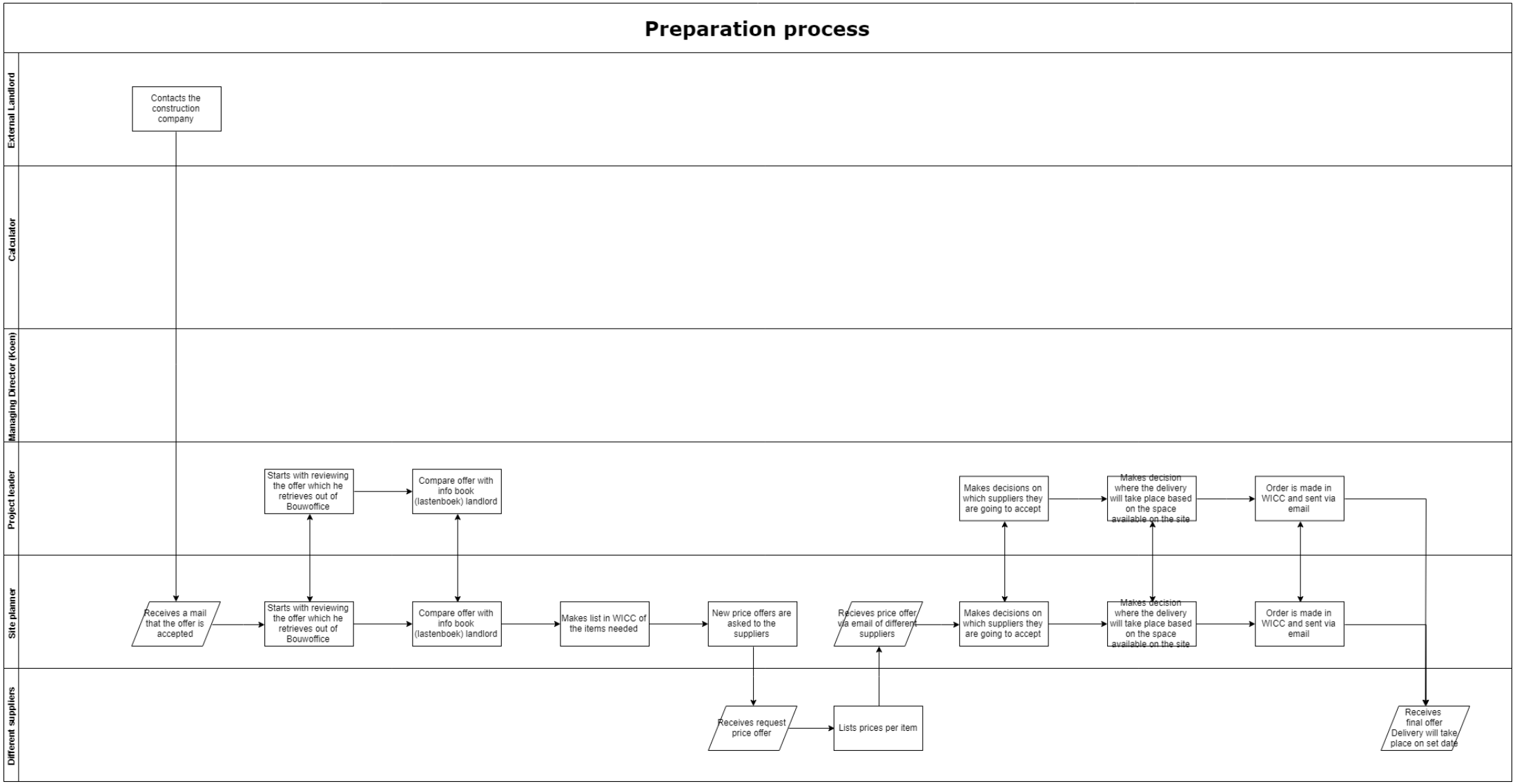
Take everything that has been discussed into account,
suppose that you understand the current situation/problem of the company. Now,
imagine that your solution has successfully been implemented and integrated at De Peuter Aannemingen.
How would the process of equipment & material leaving the warehouse look like?

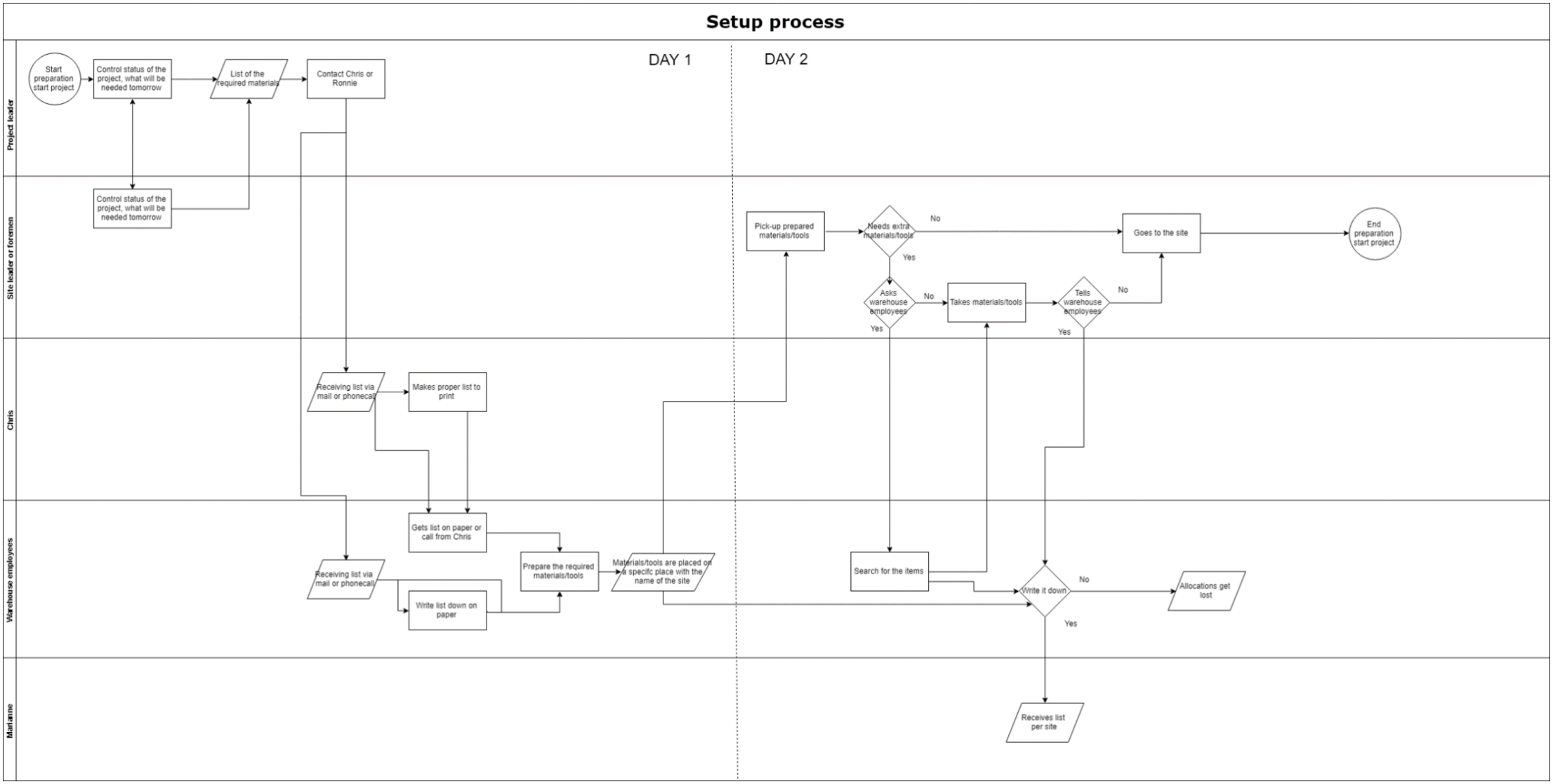
Closing questions

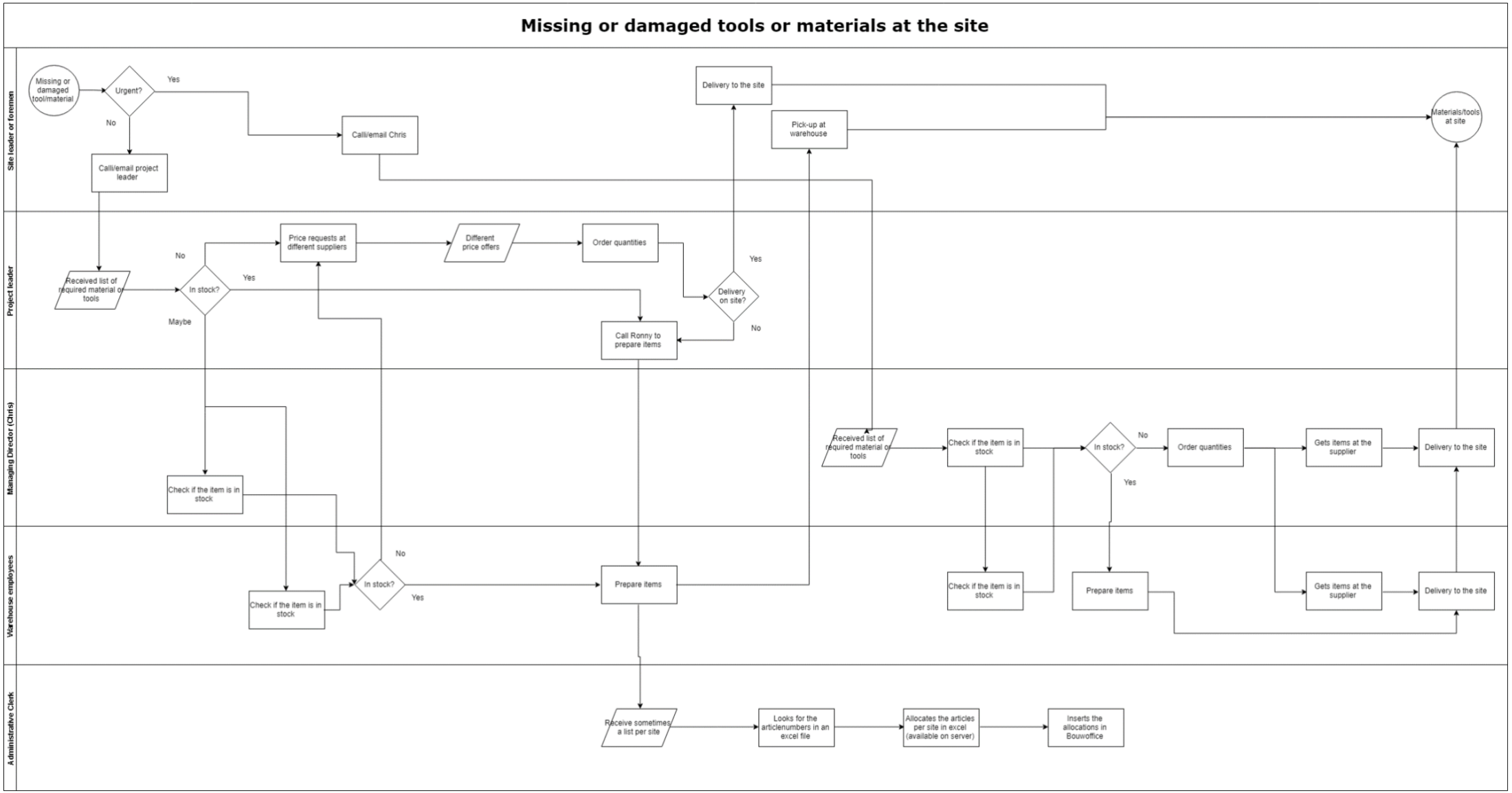
1. Do you see possibilities for an overall improvement at De Peuter?
   a. According to you, what is the way to go?
2. Do you have any remarks or advice you want to share concerning the logistics process and stock management?

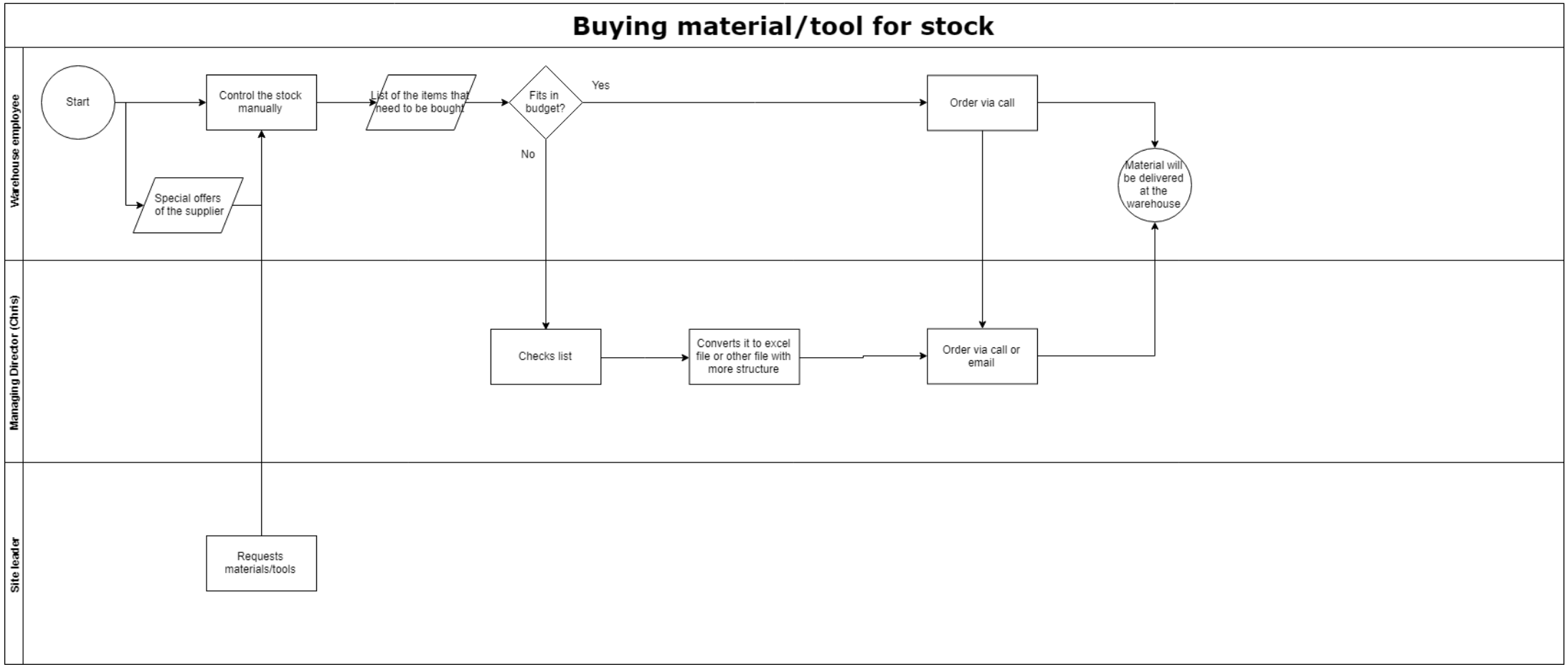
9.3 Process flowcharts

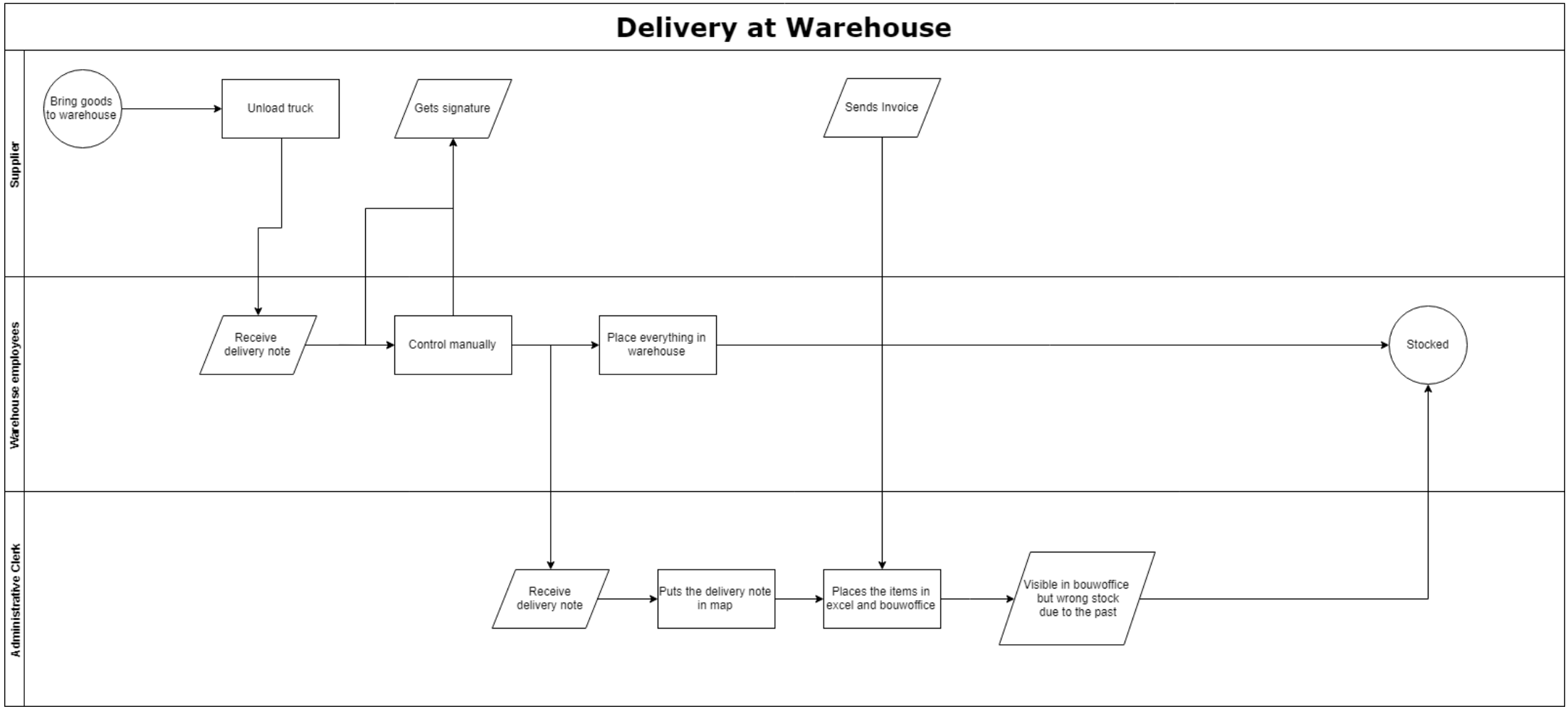


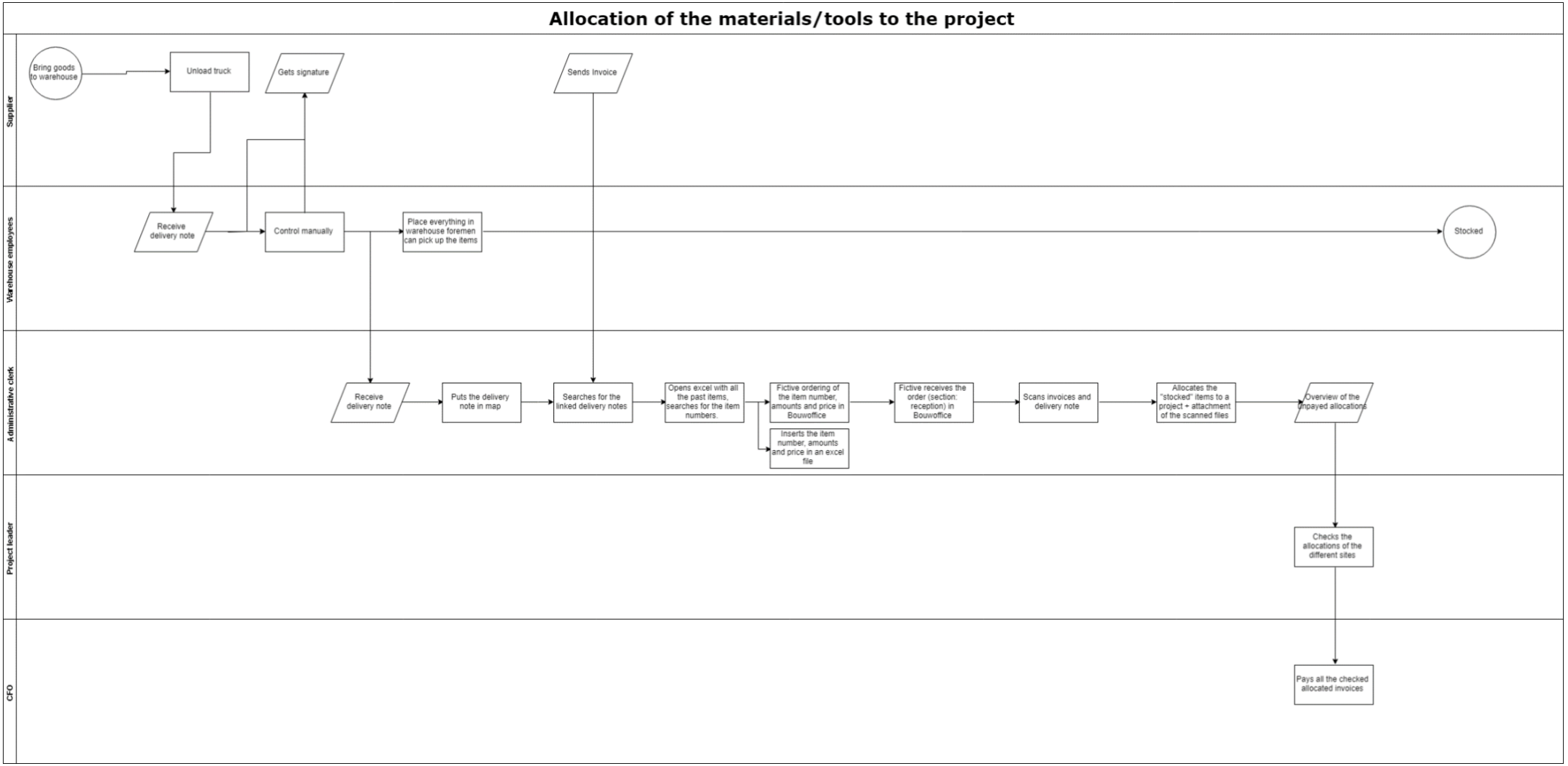

Preparation process
External Landlord
Calculator
Managing Director (Koen)
Project leader
Site planner
Different suppliers
Contacts the construction company
Starts with reviewing the offer which he retrieves out of Bouwoffice
Compare offer with info book (lastenboek) landlord
Makes decisions on which suppliers they are going to accept
Makes decision where the delivery will take place based on the space available on the site
Order is made in WICC and sent via email
Receives a mail that the offer is accepted
Starts with reviewing the offer which he retrieves out of Bouwoffice
Compare offer with info book (lastenboek) landlord
Makes list in WICC of the items needed
New price offers are asked to the suppliers
Recieves price offer via email of different suppliers
Makes decisions on which suppliers they are going to accept
Makes decision where the delivery will take place based on the space available on the site
Order is made in WICC and sent via email
Receives request price offer
Lists prices per item
Receives final offer Delivery will take place on set date

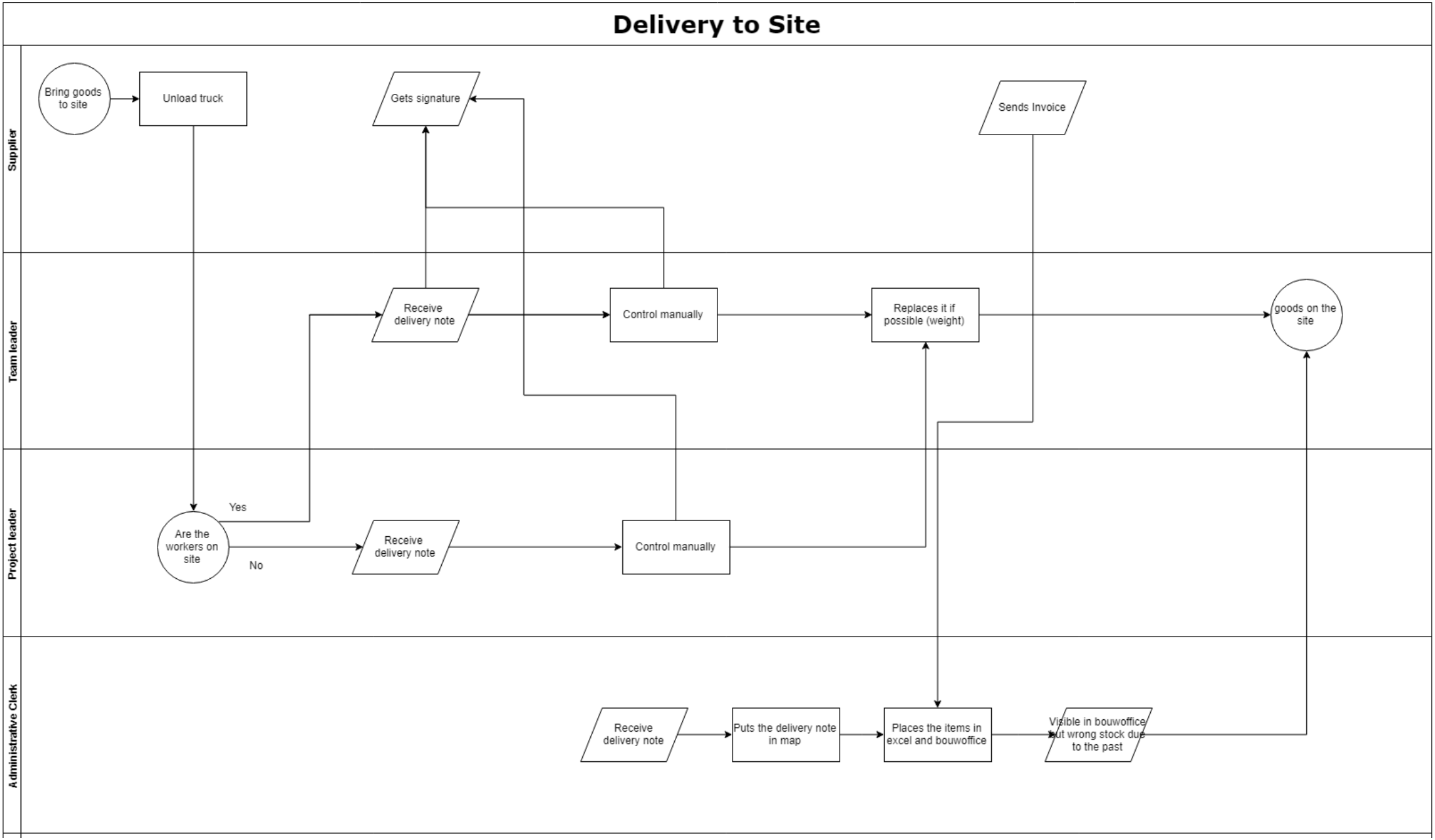

Setup process
DAY 1
DAY 2
Project leader
Site leader or foremen
Chris
Warehouse employees
Marianne
Start preparation start project
Control status of the project, what will be needed tomorrow
List of the required materials
Contact Chris or Ronnie
Control status of the project, what will be needed tomorrow
Receiving list via mail or phonecall
Makes proper list to print
Gets list on paper or call from Chris
Receiving list via mail or phonecall
Write list down on paper
Prepare the required materials/tools
Materials/tools are placed on a specifc place with the name of the site
Pick-up prepared materials/tools
Needs extra materials/tools
No
Yes
Goes to the site
End preparation start project
Asks warehouse employees
No
Yes
Takes materials/tools
Tells warehouse employees
No
Yes
Search for the items
Write it down
No
Yes
Allocations get lost
Receives list per site


Missing or damaged tools or materials at the site
Site leader or foremen
Project leader
Managing Director (Chris)
Warehouse employees
Administrative Clerk
Missing or damaged tool/material
Urgent?
Yes
No
Call/email Chris
Call/email project leader
Delivery to the site
Pick-up at warehouse
Materials/tools at site
Received list of required material or tools
In stock?
No
Yes
Maybe
Price requests at different suppliers
Different price offers
Order quantities
Delivery on site?
Yes
No
Call Ronny to prepare items
Check if the item is in stock
In stock?
No
Yes
Prepare items
Receive sometimes a list per site
Looks for the articlenumbers in an excel file
Allocates the articles per site in excel (available on server)
Inserts the allocations in Bouwoffice
Received list of required material or tools
Check if the item is in stock
In stock?
No
Yes
Order quantities
Gets items at the supplier
Delivery to the site
Check if the item is in stock
Prepare items
Gets items at the supplier
Delivery to the site


Buying material/tool for stock
Warehouse employee
Managing Director (Chris)
Site leader
Start
Control the stock manually
List of the items that need to be bought
Fits in budget?
Yes
No
Order via call
Material will be delivered at the warehouse
Special offers of the supplier
Checks list
Converts it to excel file or other file with more structure
Order via call or email
Requests materials/tools


Delivery at Warehouse
Suppiler
Warehouse employees
Administrative Clerk
Bring goods to warehouse
Unload truck
Gets signature
Sends Invoice
Receive delivery note
Control manually
Place everything in warehouse
Stocked
Receive delivery note
Puts the delivery note in map
Places the items in excel and bouwoffice
Visible in bouwoffice but wrong stock due to the past


Allocation of the materials/tools to the project
Supplier
Warehouse employees
Administrative clerk
Project leader
CFO
Bring goods to warehouse
Unload truck
Gets signature
Sends Invoice
Receive delivery note
Control manually
Place everything in warehouse foremen can pick up the items
Stocked
Receive delivery note
Puts the delivery note in map
Searches for the linked delivery notes
Opens excel with all the past items, searches for the item numbers.
Fictive ordering of the item number, amounts and price in Bouwoffice
Inserts the item number, amounts and price in an excel file
Fictive receives the order (section: reception) in Bouwoffice
Scans invoices and delivery note
Allocates the "stocked" items to a project + attachment of the scanned files
Overview of the unpayed allocations
Checks the allocations of the different sites
Pays all the checked allocated invoices


Delivery to Site
Supplier
Team leader
Project leader
Administrative Clerk
Bring goods to site
Unload truck
Gets signature
Sends Invoice
Receive delivery note
Control manually
Replaces it if possible (weight)
goods on the site
Yes
Are the workers on site
No
Receive delivery note
Control manually
Receive delivery note
Puts the delivery note in map
Places the items in excel and bouwoffice
Visible in bouwoffice but wrong stock due to the past

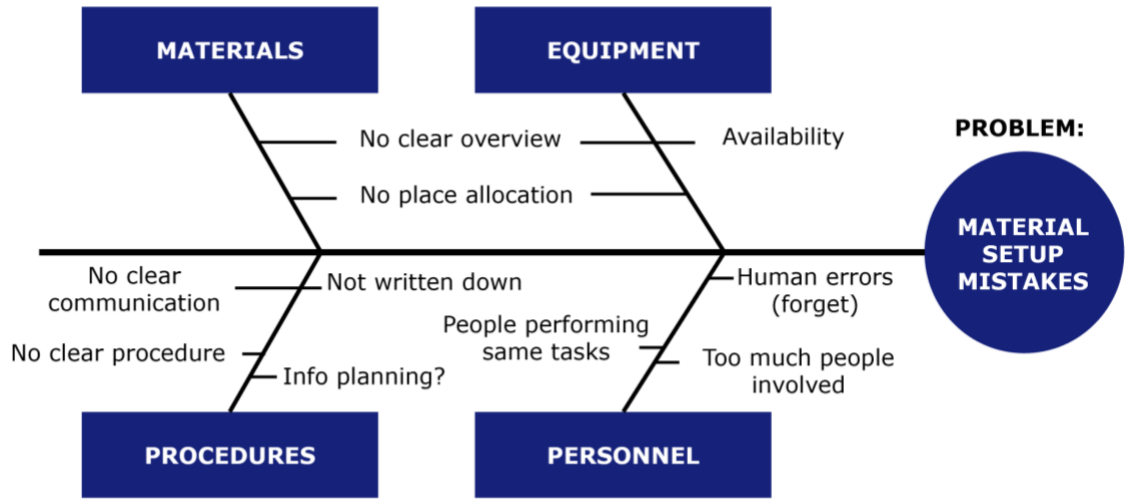
9.4 Five Why's and Fishbone diagrams

9.4.1 Preparation process

Problem	Extra costs due to making a bad decision of delivery place
Why? 1	Wrong assumptions are made
Why? 2	They do not have all the information
Why? 3	• Free space on the site (No overview of the reserved space) • Order for multiple sites • Schedule of the site not sure

Problem	Order date is to soon or to late
Why? 1	They do not want to wait for the delivery, finish it in time
Why? 2	No certainty
Why? 3	Schedule never perfect
Why? 4	Weather and unforeseen problems

9.4.2 Setup process



<u>Materials</u>

Problem	No clear overview
Why? 1	Site workers don't have access to a proper list
Why? 2	Inventory has never been registered (has never been counted and put into the system)
Why? 3	Because the registration of goods going in and out isn't done properly
	Because the employees don't execute it consistently
	• Time consuming • Not practical • Dependent on the availability of paper • They don't see the added value of registering

Problem	No place allocation
Why? 1	There's no defined structure
Why? 2	Restructuring costs a lot of time and effort
Why? 3	The people in charge have other tasks to complete

Equipment

Problem	No clear overview
Why? 1	Site workers don't have access to a proper list
Why? 2	Inventory has never been registered (has never been counted and put into the system)
Why? 3	Because the registration of goods going in and out isn't done properly
	Because the employees don't execute it consistently
	• Time consuming • Not practical • Dependent on the availability of paper • They don't see the added value of registering

Problem	Place allocation is not followed
Why? 1	Construction workers leave the equipment anywhere
Why? 2	• Convenience • No clear knowledge of what belongs where

Problem	Availability is not known
Why? 1	There is no accessible list of equipment availability
Why? 2	No real-time registration of what leaves and enters the warehouse
Why? 3	The current methods of registration are too time-consuming
Why? 4	Too many (manual) steps

Procedure

Problem	No clear procedure
Why? 1	It has never been introduced
Why? 2	No one has ever taken the initiative to change
Why? 3	All employees have their own tasks to fulfil

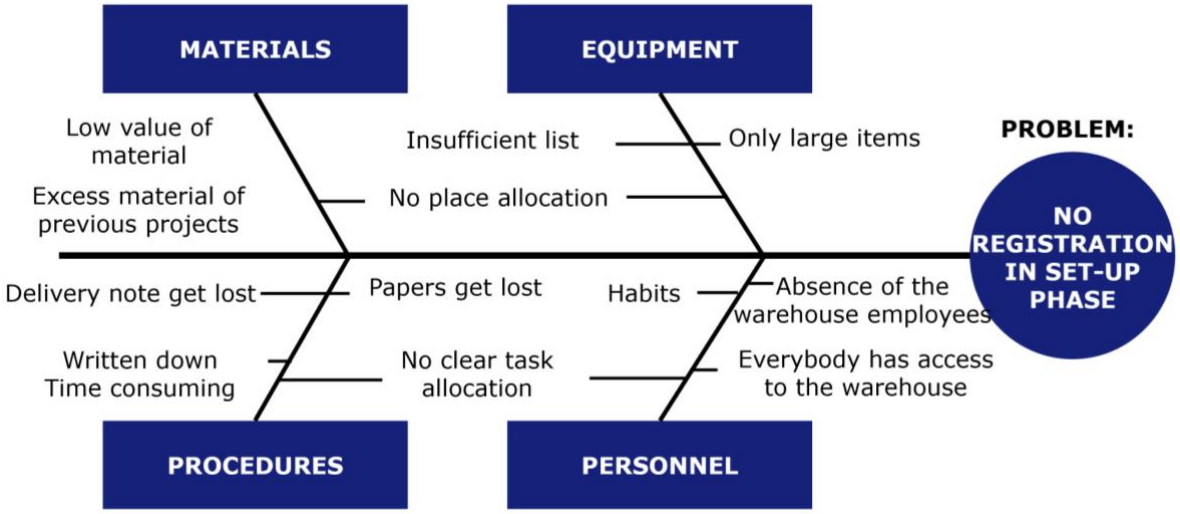
Problem	Communication is unclear
Why? 1	Different names for the different materials
Why? 2	Personal habits and experience

Problem	Sometimes not written down
Why? 1	Orders come in simultaneously and urgently (time constraint)
Why? 1	Human errors
Why? 1	Goods are taken by other workers
Why? 2	• Warehouse manager is not present and warehouse is not locked • They don't know they have to

Problem	Information about the scheduling of projects is unclear
Why? 1	The planning is not communicated to everyone
Why? 2	They do not see the purpose of it

PERSONNEL

Problem	T**oo much people involved**
Why? 1	No clear job allocation for the warehouse managers/mechanics
Why? 2	It has always worked like this



Materials

Problem	**Low value materials are not registered**
Why? 1	They think it's not worth the effort
Why? 2	Old habits

Problem	**Excess material of previous projects is not registered**
Why? 1	Cost is already allocated to the project it's coming from
Why? 2	Calculations include a margin to 'be safe'
Why? 3	To avoid the risk of having to order extras
Why? 4	It takes extra effort and time

Equipment

Problem	**Urgent equipment needs**
Why? 1	Something is forgotten
Why? 2	Order for equipment is incomplete
Why? 3	Human errors
Why? 4	• Orders happen over the phone and in multiple steps • No checklist

Problem	**Small items are not registered**
Why? 1	They aren't considered a substantial cost
Why? 2	Larger quantities in stock
Why? 3	They have a lower value

Procedure

Problem	**Transfer note gets lost or forgotten**
Why? 1	It's not handled real-time, but via a paper
Why? 2	There's various manual steps involved
Why? 3	The process is executed by various people

Problem	**Different steps are time consuming**
Why? 1	Last person in the chain has to decipher transfer note
Why? 2	The transfer receipt is manually filled in

Personnel

Problem	Absence of warehouse employees
Why? 1	No full-time warehouse manager
Why? 2	No clear task allocation
Why? 3	Too many jobs for one person
Why? 4	Frequent and urgent needs for mechanics and transport

Problem	Everybody has access to the warehouse
Why? 1	The warehouse isn't locked
Why? 2	The lack of structure makes it impossible to close off the warehouse

Problem	Employees' habits
Why?	They are not being involved in the process

9.4.3 Missing or damaged tools/materials at the site

Problem	The procedure is not clear
Why? 1	Multiple people are involved
Why? 2	In urgent cases, Chris is called
Why? 3	Experience shows that he is effective in doing so
Why? 4	He has the authority to delegate people and to order what's needed

Problem	Chris often physically goes to the warehouse to check if there is stock
Why? 1	He doesn't want to order something that they have in stock
Why? 2	He doesn't have a clear overview

Problem	On site deliveries are executed by too many people
Why? 1	It depends on the availability
Why? 2	People have overlapping responsibilities
Why? 3	No clear task allocations

Problem	Project leaders don't have real-time information about their projects.
Why? 1	When an order is made this is not registered in Bouwoffice.
Why? 2	Order is not linked with Bouwoffice
Why? 3	Marianne inserts the order in Bouwoffice when she receives an invoice
Why? 4	She wants to compare the delivery note with the invoice
Why? 5	It is sometimes unclear what is written (description, amount, price, etc.)
Why? 6	Everything is done manually
Why? 7	No other method is given

Problem	The managing director spends excessive time delivering goods to the construction sites.
Why? 1	In urgent cases, Chris is personally contacted and takes ownership of the ordering and transportation of the goods.
Why? 2	Warehouse employees are not available
Why? 3	It's the fastest way
Why? 4	Chris can autonomously make decisions

9.4.4 Buying tools/materials for stock

Problem	A lot of time is wasted on checking the stock levels
Why? 1	No minimum or maximum stock levels (no indicators)
Why? 2	Everything is done manually.
Why? 3	There is no other option

Problem	Goods are out of stock
Why? 1	They are being overlooked
Why? 2	Things get forgotten (human errors)
Why? 3	Manual check-up (on paper)

9.4.5 Delivery to the warehouse

Problem	Delay of registered deliveries
Why? 1	Marianne waits for invoice
Why? 2	Not all the required information is mentioned on the delivery note
Why? 3	Delivery note is to check the delivery itself

Problem	Incoming goods are not accurately registered
Why? 1	Mistakes in occur in the checking procedure
Why? 2	The non-stock deliveries are not checked
Why? 3	Warehouse employees do not know when or what is ordered
Why? 4	Warehouse employees do not have access to the information.

9.4.6 Allocation of the tools/materials to the projects

Problem	No real time data of the delivered orders
Why? 1	Allocation does not happen on arrival
Why? 2	Too many steps
Why? 3	Marianne waits for the invoice
Why? 4	Marianne checks the delivery note and the invoice
Why? 5	She does not use the order receipt
Why? 6	She does not have access to the order receipt, or the receipt is not existent

Problem	Marianne loses a lot of time in the allocation
Why? 1	Uses excel to find the item number in Bouwoffice
Why? 2	No clear description of the item
Why? 3	Difference in descriptions between different suppliers and employees
Why? 4	Marianne does not have the same technical knowledge as warehouse employees

9.5 Example of standardised procedures

Based on Nakagawa (2005).

Order tools/materials at the warehouse

De Peuter nv

#01

June 14, 2019

By

ICP - Vlerick Business School

DRAFT EXAMPLE

APPROVED:

A. PURPOSE

This procedure is applicable for the ordering of tools or materials at the warehouse. It implies the communication between construction site and warehouse, the availability of the material and the checklist.

B. SAFETY

No direct safety guidelines apply on this procedure. The warehouse needs to provide the safety documents with the tools or materials, if this is necessary.

C. EQUIPMENT

A computer needs to be available to generate an ordering list.

D. RESPONSIBLES
   1. Foremen
   2. Project leader or Site leader
   3. (Warehouse employee)

E. PROCEDURE

Selecting the items

1. The foremen makes a list of the tools and the materials which are needed for the next day. Therefore use the template in the appendix or/and a checklist of standard work events.
   If a computer is at their disposal, this needs to be made in the excel template (Setup_Template).
2. The same material description needs to be used as in the stock list (see appendix).
3. The list of all the items is sent to the project leader via email (or via phone, if no computer is at the foremen's disposal).
   THE LIST NEEDS TO BE SENT BEFORE 14H FOR THE NEXT DAY
4. The project leader checks the availability of the required items in the warehouse.
   A list of the available items can be retrieved on the logistic module of BouwOffice.

Make an order at the warehouse

1. The items that are rented or bought from the warehouse are placed in the ordering excel template which can be found on the server.
2. The file needs to be renamed, filename:
   SETUPDATE_ AMOUNTOFITEMS_CITY_PROJECTNUMBER
   (e.g. 17062019_12_NOORDERWIJK_A251)
3. The ordering file needs to be saved on the server in folder "WAREHOUSE_SETUP"
   The order at the warehouse is made BEFORE 15H FOR THE NEXT DAY.

Make an order at an external party

1. A list of all the ordered items are sent towards the supplier via email. This can change depending on the ordering process of the supplier.
2. Each order needs to have an order receipt containing the following information. Clear description, amount and price).

3. The order receipt needs to be made as a pdf and saved with filename: ORDERDATE_ PROJECTNUMBER_CITY_AMOUNTOFITEMS
   (e.g. 17062019_A251_NOORDERWIJK_12)
4. The order receipt needs to be saved on the server in folder “ORDER_RECEIPTS”

F. EXCEPTIONS

- When the project leader or a site leader is not present to make the orders, the site planner can make the orders.
- The warehouse manager has the right to decline an order if the number of items or the complexity is too large concerning the timeframe between order and setup date. The refusal is always communicated to the project leader, immediately after the decision is made.

G. CONTROL

- All breaches of deadlines are reported and discussed on the monthly meeting.

CHECKLIST POURING CONCRETE:

	Description (NL)	Item number	Amount	Selling or renting	Rental Time	CONTROL
1	Bekisting plaat 500x500x2cm	000256	X*	renting	4 weeks	
2	Afstandhouders	000052	X*	sold	-	
3	Wapening	000021	X*	sold	-	
4	Binddraad 50m	000014	X*	sold	-	
5	Betonkubel	000001	1	renting	1 week	
6	Trilnaald	000004	2	renting	1 week	

*X = depends on the project itself

TEMPLATE:

	Description	Item number	Amount	Selling or renting	Rental Time
1	Example – Binddraad 50m	00000001	1	SELLING	2 weeks
1					
2					
3					
4					
5					

Setup tools/materials at the warehouse

De Peuter nv

#WR01

June 14, 2019

By

ICP - Vlerick Business School

DRAFT EXAMPLE

APPROVED:

A. PURPOSE

This procedure is applicable for the setup of tools or materials at the warehouse. It implies the communication between warehouse and construction site, registration process of the items and the placement of the setups.

B. SAFETY

Safety guidelines concerning the machines that are used to pick the items can be retrieved at the machine itself.

C. EQUIPMENT

- Warehouse employees have a computer at their disposal to register the items and a printer.
- Stickers to allocate the orders.

D. RESPONSIBLES

1. Warehouse Manager
2. Warehouse employees

E. PROCEDURE

Search and print

1. Check the folder “WAREHOUSE_SETUP” and print the order lists.
2. Replace the printed file to a new folder “WAREHOUSE_BUSY”

Picking

3. Pick the items as in the order list, check manually at the printed list
4. Check the rented material for damages
5. Place the order at the foreseen position, with a sticker of the order number, project number, project city and setup date.

Registration

6. Open the excel file in folder “WAREHOUSE_BUSY”
7. All the picked items are checked in the excel file.
8. If an item is out of stock or damaged is this mentioned in the order list.
9. Replace the file to folder “WAREHOUSE_REGISTRATION”
10. Send the excel file to the project leader of the project
    a. Title of the mail: CHECKED ORDER. If no problems occurred.
    b. Title of the mail: PROBLEM ORDER. If a problem occurred (e.g. item out of stock)

F. EXCEPTIONS

G. CONTROL

- All breaches of non-registrations and not alerting the project leader are discussed during the monthly meeting.